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SP

Installation Instructions

FFDM-S Service Manual DRC

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Full Field Digital Mammography (FFDM-S)

Service Manual

Direct Radiography Corp.
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About This Manual

This manual contains service information for the DirectRay Full Field Digital Mammography (FFDM-S) system components. It includes an overall description of how the system operates as well as providing detailed service support procedures such as installation, calibration, and troubleshooting.

Intended Use

Digital images can be viewed, stored, or printed. The system provides a digital image capture capability for radiographic examinations for mammography.

Organization

Chapter 1: Introduction

Provides a description of the DirectRay FFDM-S components.

Chapter 2: Theory of Operation

Explains the sequence of internal operations that occur with system components during exposures. It also describes the DirectRay technology used in the DirectRay Detector.

Chapter 3: Installation

Provides guidelines for installing the hardware components of the DirectRay FFDM-S system

Chapter 4: Calibrating the AEC

Describes how to calibrate the AEC by generating a goal table for a desired target/filter combination and loading it into the DirectRay Power and X-ray Control Module (PXCM).

Chapter 5: PXCM Web Tool

Describes Detector- and PXCM-related service tasks using the DirectRay PXCM Web Tool.

Chapter 6: Maintaining Image Quality

Contains information to help maintain acceptable image quality.

Chapter 7: Troubleshooting

Provides guidelines on how to troubleshoot the DirectRay components.

Chapter 8: Replacement

Provides replacement guidelines for the DirectRay system components, and explains how to pack the Detector for shipment back to Direct Radiography Corp.

Appendix A: Specifications

Provides specifications for the DirectRay FFDM-S components.

Appendix B: Field Replaceable Units

Provides a listing of the FRUs for the DirectRay FFDM-S components.

Conventions Used in This Manual

This manual uses three types of special messages to emphasize information or point out potential risks to personnel or equipment. A sample of each message type follows.

NOTE: *Notes provide additional information, such as expanded explanations, hints, or reminders.*

CAUTION Cautions point out procedures that you must follow precisely to avoid damage to equipment, loss of data, or corruption of files in software applications.

WARNING Warnings point out procedures that you must follow precisely to avoid injury to yourself or others.

1

Introduction

This chapter provides the general overview of the DirectRay Full Field Digital Mammography (FFDM-S) system and its components. It also includes safety and compliance information.

What Is the DirectRay FFDM-S System?

The DirectRay FFDM-S system is composed of the following components in a direct-to-digital X-ray mammography imaging system:

- The DirectRay Detector, which converts X-rays into digital data
- The DirectRay Power and X-ray Control Module (PXCM), which acts as the interface between the generator, the DirectRay Detector, and the FFDM-S Acquisition Workstation software.
- The DirectRay Interface card, a PCI card located in the Acquisition Workstation, which provides the fiber optic cable connection between the PXCM and the Acquisition Workstation.

These components are implemented with a generator, tube stand, bucky, and Acquisition Workstation to form a complete mammography system.

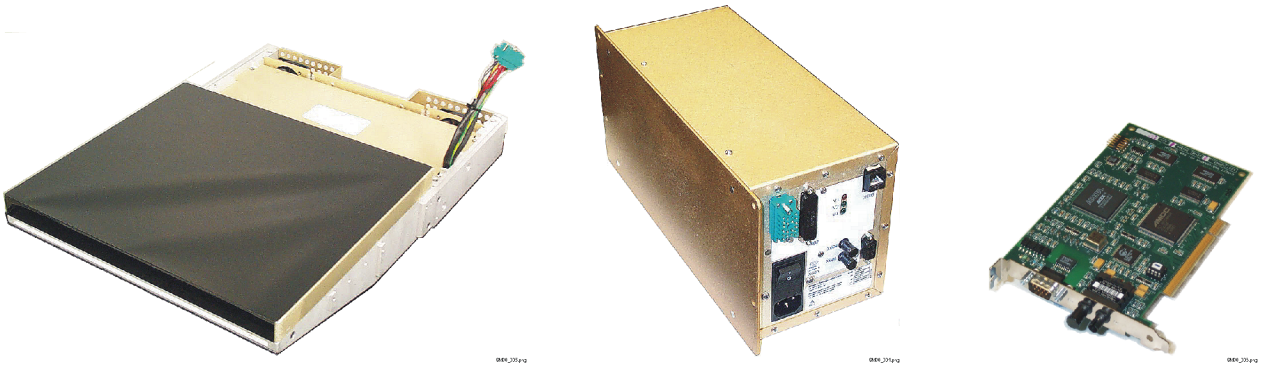


Figure 1-1. *DirectRay FFDM-S Hardware Oomponents*

General Safety and Compliance Information

Safety Precautions

- Observe all warnings and cautions in the procedures.
- Follow all safety labels on the equipment.

General Use Cautions and Warnings

CAUTION Federal (USA) law restricts this device to sale by or on the order of a physician (or properly licensed practitioner).

WARNING The DirectRay FFDM-S system includes no user serviceable parts. For service assistance, contact the vendor who supplied the system.

United States Federal and State Regulations

DirectRay FFDM-S systems conform to the United States Code of Federal Regulations, 21 CFR 1020.30 “Diagnostic X-Ray Systems and their major components.” However, additional state regulations may apply for X-ray products. This may require notifying your state regulatory agency about your installation and/or operator training and certification.

It is the responsibility of the user to contact the applicable state radiation control agency to verify that your installation is in compliance with regulations in your state governing installation and use of X-ray equipment.

IEC Regulations

Software used in the DirectRay FFDM-S system was developed using IEC 60601-1-4 as a guide.

Manufacturer’s Responsibility

This equipment is sold with the understanding that Direct Radiography Corp., its agents and representatives, do not accept any responsibility for overexposure of patients or personnel to X-radiation.

Furthermore, Direct Radiography Corp. does not accept any responsibility for overexposure of patients or personnel to X-radiation generated by this equipment as a result of poor operating techniques or procedures.

Also, no responsibility is assumed for any unit that has not been serviced and maintained in accordance with the technical service manual, or which has been modified or tampered with in any way.

Caution Regarding Small-Detail Object Imaging

As with all digital imaging devices, there is the potential that small-detail structures, high-contrast edge structures, and fine-line structures with a repeating pattern could appear differently in the digital image than in an image created with an analog device—such as screen–film system—or with another digital device having smaller individual detector elements. For example, for a sharp-edged object, the edges of that object may appear to have "stair-steps" when in fact the object edge does not have such structure. This is an effect of digital undersampling.

For small-detail objects having a size on the same order of magnitude as an individual pixel or smaller, the apparent contrast of that object can vary based on the position relative to the individual detector element locations. For example, the contrast of a single spherical object the same size as a pixel would have a different appearance if the object were imaged directly overlying a detector element (highest contrast) or placed at the intersection of four detector elements (lowest contrast). Objects inherently smaller than individual pixels will have a lower apparent contrast because of the digital sampling of the analog radiation intensity signal over an area larger than the small object. In each case, a lower apparent signal-to-noise can result in reduced visibility of such objects.

Restrictions on Use

The customer is responsible for assuring that accessories used with the DirectRay FFDM-S system do not degrade the safety of the system.

Accessories and interfacing equipment used in conjunction with the DirectRay FFDM-S system and located outside the patient environment may be exempt from EN60601-1. Such equipment must, however, conform to EN60601-1-1 and therefore to standards applicable to information technology equipment such as EN60950 and to applicable electromagnetic compatibility requirements.

Detector Safety and Compliance Information

Environment

The operating environment is 20° to 35°C (68° to 95°F), 10 to 80% Relative Humidity (non condensing). Make sure the ventilation openings at the rear of the detector are not obstructed. For storage and transportation, the temperature range must stay within 10° to 40°C (50° to 104°F) or permanent damage may occur. Such damage could be considered misuse and may not be covered under warranty.

Do not autoclave this equipment.

Certification

UL Recognized Component certified to be in compliance with applicable requirements of:

- UL 2601-1, Second Edition including Amendments 1 and 2
- CAN/CSA C222 No. 601.1-M909

Use of the FFDM-S with equipment not complying with equivalent safety requirements may lead to a reduced level of safety in the resulting system. There must be evidence that added equipment has been certified for safety in accordance with the appropriate IEC 601-1 and/or IEC 601-1-1 harmonized national standard. Otherwise use within the defined Patient Vicinity is not approved. Testing of the FFDM-S in combination with the end use equipment shall include leakage current test, ground continuity tests, temperature tests and other tests as required by the appropriate standards. The maximum operating temperatures of certain safety components, as defined in the applicable safety standards, must not be exceeded in the end use installation to maintain the intended safety. The FFDM-S is intended to be installed as part of x-ray equipment and serviced only by persons trained and approved to work on that specific equipment, using the appropriate tools.

Classification

With reference to subclause 5 of IEC 60601-1:

- Protection against electric shock (5.1, 5.2) Class I.
- Applied Parts: Type B Applied Parts.
- Protection against harmful ingress of water (5.3) Ordinary.
- Degree of safety in the presence of flammable anesthetics or oxygen (5.5). Not suitable for use in the presence of flammable anesthetics or oxygen.
- Mode of Operation (5.6): Continuous.

Warnings, Cautions, and Notes

WARNING A Protective Earth Ground connection to the FFDM-S Detector shall be provided in the end use equipment installation.

WARNING Dangerous Voltages are present on some components, printed wiring traces, and heatsinks. A blown fuse is an indication of a catastrophic failure of circuit components. Unauthorized replacement may result in a risk of fire.

CAUTION Some of the electronic components used in this product may be damaged by static electricity or electrostatic discharge. Unpack and handle using appropriate precautions.

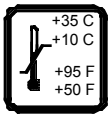
CAUTION Each image detector is provided with a CD-ROM containing data for initial gain calibration and defect mapping. The gain calibration process must be performed again when installed at the end user site to compensate for variations in the specific x-ray tube, breast tray, compression paddle, grid, and all other parts of the image path. Any dirt, debris, or foreign objects in the path between X-ray source and image detector elements at time of calibration may adversely affect subsequent images. Calibration should be repeated at regular intervals to maintain image quality. Defect mapping can be verified and updated by authorized service personnel.

NOTE: *This product must be returned to the manufacturer for proper disposal of the selenium and related electronic materials.*

Symbols Used

Danger! Hazardous Voltages are present within this equipment.

Attention! Consult this accompanying document for valuable information on the safe and effective use of this product.



This thermometer symbol indicates the recommended operating temperature range of 20° to 35°C (68° to 95°F). A similar symbol appears on the product packaging indicating that during storage and transportation the temperature must stay within 10° to 40°C (50° to 104°F).

Special Cleaning Instructions:

Do not spray cleaning solution directly on the equipment. Instead, moisten cloth with the solution and wipe the Detector.

Fragile - Handle with care.

Do not immerse the equipment in liquid.

This product contains no user serviceable parts. Assembly of this product is done under controlled clean room conditions. Exposing the more sensitive internal parts lesser environments may permanently affect product performance.

Do not to operate this equipment in the presence of flammable anesthetics or high levels of oxygen. The gas bottle and flame are a visual reminder of a hazard that usually cannot be seen.

This equipment has been determined to be Type B equipment providing a particular degree of protection against electric shock.

PXCM Safety and Compliance Information

Environment

The operating environment is 10° to 50°C (50° to 122°F), 10 to 80% Relative Humidity (non condensing).

Certification

UL Recognized Component certified to be in compliance with applicable requirements of:

- UL 2601-1, Second Edition including Amendments 1 and 2
- CAN/CSA C222 No. 601.1-M909

Use of the PXCM-S with equipment not complying with equivalent safety requirements may lead to a reduced level of safety in the resulting system. There must be evidence that added equipment has been certified for safety in accordance with the appropriate IEC 601-1 and/or IEC 601-1-1 harmonized national standard. Otherwise use within the defined Patient Vicinity is not approved. Testing of the PXCM-S in combination with the end use equipment shall include leakage current test, ground continuity tests, temperature tests and other tests as required by the appropriate standards. The maximum operating temperatures of certain safety components, as defined in the applicable safety standards, must not be exceeded in the end use installation to maintain the intended safety. The PXCM-S is intended to be installed within X-ray equipment and serviced only by persons trained and approved to work on that specific equipment, using the appropriate tools.

Classification

With reference to subclause 5 of IEC 60601-1:

- Protection against electric shock (5.1, 5.2) Class I.
- Protection against harmful ingress of water (5.3) Ordinary.
- Degree of safety in the presence of flammable anesthetics or oxygen (5.5). Not suitable for use in the presence of flammable anesthetics or oxygen.
- Mode of Operation (5.6): Continuous.

Warnings and Cautions

WARNING Dangerous Voltages are present on some components, printed wiring traces, and heatsinks. A blown fuse is an indication of a catastrophic failure of circuit components. Unauthorized replacement may result in a risk of fire.

CAUTION This unit includes a lithium battery. Do not attempt to disassemble or recharge it. Do not dispose of the battery in fire.

CAUTION Some of the electronic components used in this product may be damaged by static electricity or electrostatic discharge. Unpack and handle using appropriate precautions.

CAUTION Dielectric strength test caution: (Statement from Condor DC Supplies Inc. regarding their GSM28-5 power supply) "When performing Dielectric Strength Tests, catastrophic failure of the unit may result if a Dielectric Strength test voltage greater than 1800 Vac is applied between primary and secondary circuits. The components providing isolation from primary to secondary cannot be tested while installed in the power supply without overstressing basic (primary to ground) insulation. All isolating components are individually 100% tested at 4800 Vac prior to installation."

2

Theory of Operation

This chapter explains the sequence of internal operations that occur with system components during exposures. It also describes the DirectRay technology used in the DirectRay Detector.

Normal Operations Sequence

A flowchart of the normal workflow is illustrated in Figure 2-1 on page 2-2. Understanding the normal operation of the system facilitates troubleshooting to isolate the possible causes of problems.

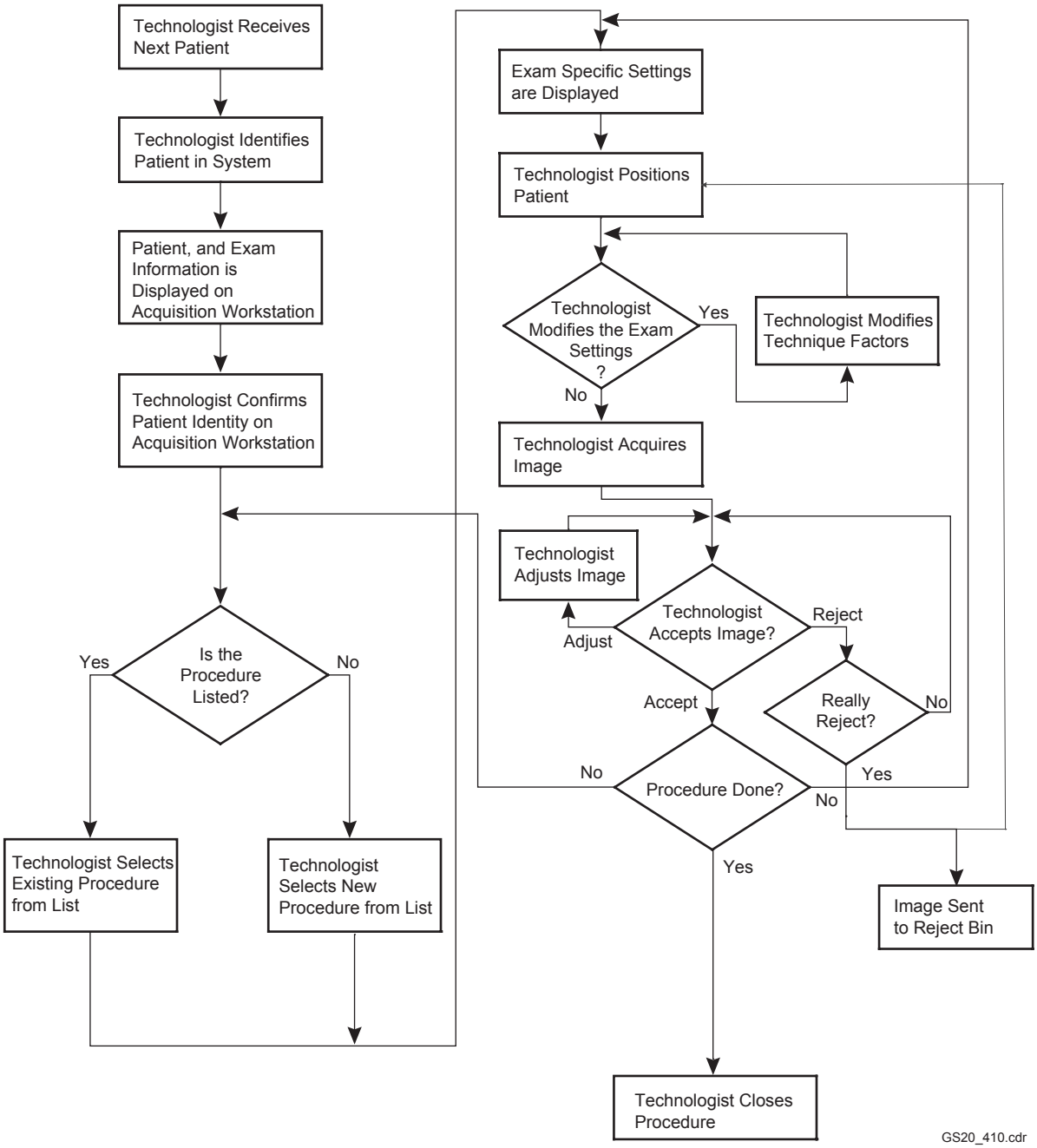


Figure 2-1. *Normal Workflow of the X-ray System*

Communication Between the PXCM and the Generator During an Exposure

The interface between the DirectRay Power and X-ray Control Module (PXCM) and the Generator consists of seven hardware signals and regular exchange of messages over an RS232 serial communication link.

There are two exposure operating modes: Manual and Automatic Exposure Control (AEC). The exposure sequence is slightly different between the two modes. The main difference is that the AEC exposure actually consists of two exposures: a short pre-exposure; followed by the measurement, calculation, and transfer of the required mAs value from the PXCM to the Generator; followed by the main exposure.

Figure 2-2 on page 2-4 and Figure 2-3 on page 2-5 show the signals and their relative occurrence in time.

NOTE: *The PXCM is also referred to as the "brick." Therefore, you will see the terms "PXCM" and "brick" used interchangeable throughout this topic.*

Additional Information About AEC Mode

During AEC mode:

1. A 5-mAs pre-exposure is made.
2. The actual mAs of the pre-exposure is sent from the Generator to the PXCM in a code-S message.
3. The PXCM collects the resulting pixel values, binned together in super pixels (128 x 128 pixels), from the Detector.
4. Using these super pixel values and the exposure parameters (for example, kV and speed, supplied in the code-X message) of the exposure, the PXCM calculates the required mAs value (which depends on the desired pixel value) to be used for the main exposure.
5. The calculated mAs value is made available to the Generator by a code-B message from the PXCM.
6. Once the calculated mAs value has been set up in the Generator, the Generator sends a code-Y message to the PXCM.
7. The PXCM again activates its DR_DET_RDY_FOR_EXP_ signal; the Generator starts the grid and, when in position, starts the actual exposure.

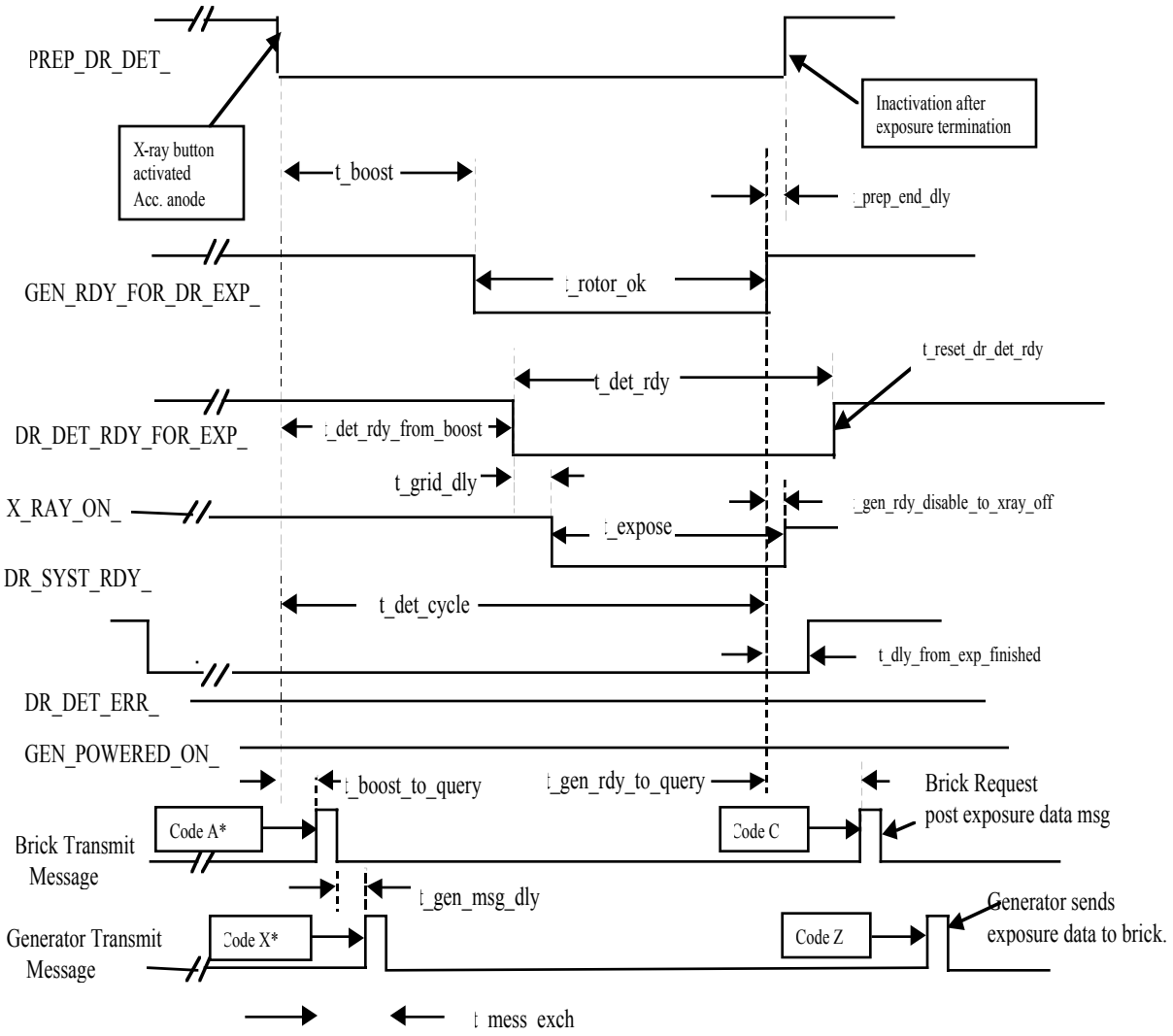


Figure 2-2. *Timing Diagram for PXCM/Generator Communications in Manual Mode*

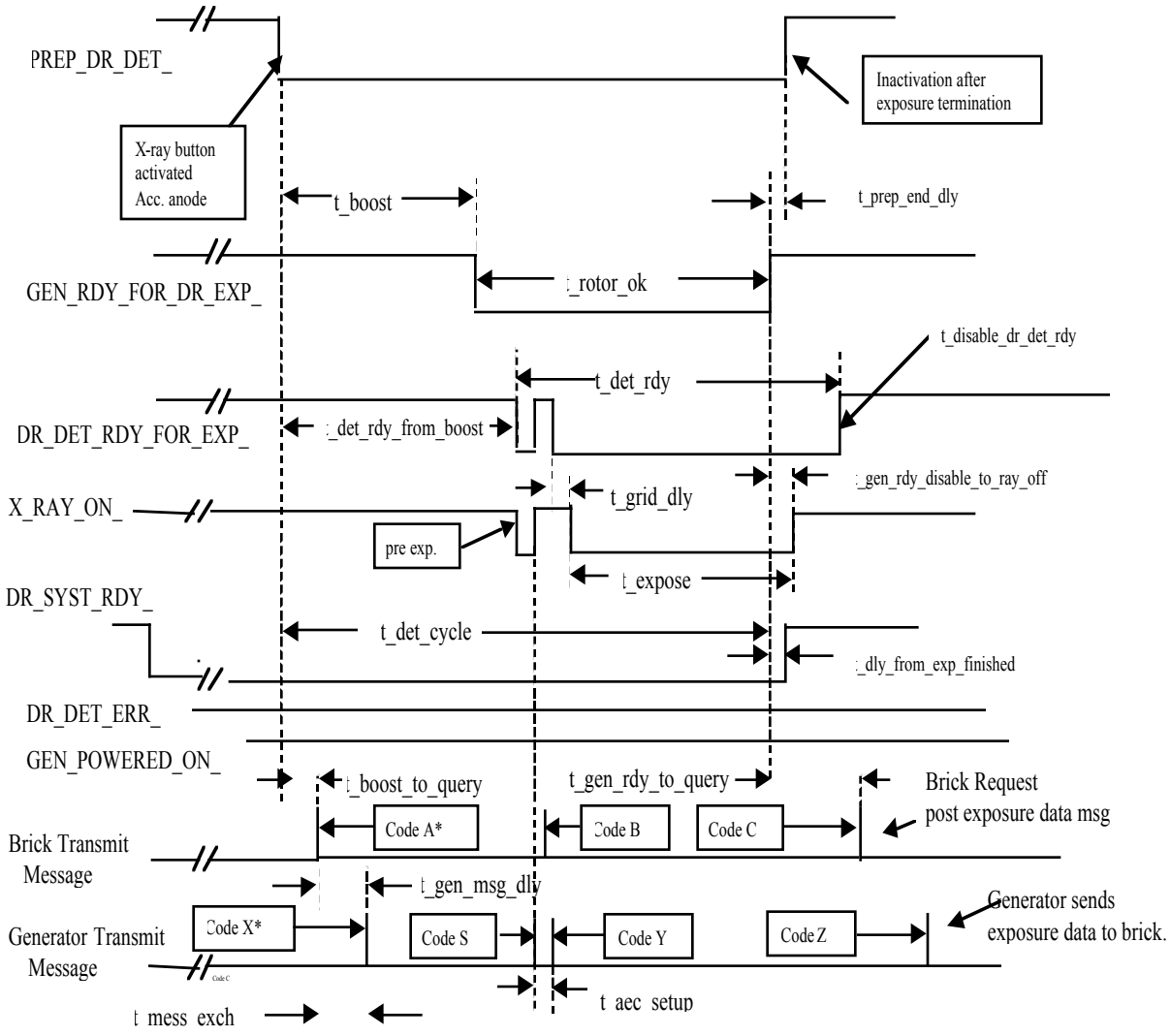


Figure 2-3. *Timing Diagram for PXCM/Generator Communications in AEC Mode*

Table 2-1. Exposure Signals Between PXCM and Generator

Signal	Direction	Description
PREP_DR_DET_	Generator to PXCM	The Generator has started the preparations to perform an exposure. **Activation:** The Generator activates the signal when the exposure preparations have started. **Deactivation:** The Generator deactivates the signal when: • The exposure buttons are released. • A correctly terminated exposure has been proceeded.
PREP_DR_DET_	Generator to PXCM	**Deactivation:** The Generator deactivates the signal when: • An error interrupts the exposure. For timing requirements, see t_prep_end_dly.
GEN_RDY_FOR_DR_EXP_	Generator to PXCM	The Generator is ready to expose. **Activation:** When the anode speed is reached, the signal is activated. **Deactivation:** The Generator deactivates the signal when: • The exposure buttons are released. • A correctly terminated exposure has been proceeded.
GEN_RDY_FOR_DR_EXP_	Generator to PXCM	**Deactivation:** The Generator deactivates the signal when: • An error interrupts the exposure. For timing requirements, see t_gen_rdy_disable_to_ray_off. ***Note:*** *For an AEC pre-exposure, the signal will stay active in the time interval between the AEC pre-exposure and the AEC main exposure.*
DR_DET_RDY_FOR_EXP_	PXCM to Generator	The Detector is ready for an exposure. **Activation:** When the Detector is ready to receive X-rays, the signal is activated.
DR_DET_RDY_FOR_EXP_	PXCM to Generator	**Deactivation:** When the Detector exposure window ends, the signal is deactivated.

Table 2-1. Exposure Signals Between PXCM and Generator

Signal	Direction	Description
X_RAY_ON_	Generator to PXCM	The Generator is emitting X-rays. **Activation:** When the HV is applied to the X-ray tube, the signal is activated. **Deactivation:** When the HV is switched off, the signal is deactivated. ***Note:*** *The emission can be pulsed but the signal will stay on for the duration of the full exposure.*
DR_SYST_RDY_	PXCM to Generator	The DirectRay Detector subsystem is prepared for an exposure request. **Activation:** When the DirectRay system is ready to receive the signal PREP_DR_DET_, the signal DR_SYST_RDY is activated. **Deactivation:** When the signal GEN_RDY_FOR_DR_EXP_ is deactivated, the signal DR_SYST_RDY_ is deactivated. For timing requirements, see t_dly_from_exp_finished.
DR_DET_ERR	PXCM to Generator	An error is present in the DirectRay system. **Activation:** When there is an error condition within the DirectRay system, the signal is activated. **Deactivation:** When the error condition has been cleared, the signal is deactivated.
GEN_POWERED_ON_	Generator to PXCM	The Generator is powered on. **Activation:** Whenever the Generator is powered on, the signal is activated. **Deactivation:** Whenever the Generator is powered off, the signal is deactivated.

DirectRay Technology

Indirect Versus Direct X-ray Capture

Most digital X-ray detectors use a scintillator, such as Cesium Iodide (CsI), or phosphor as the X-ray capture media. As illustrated in Figure 2-4, this "indirect" method requires converting the X-ray signal to light, which is then used to create a charge which is later digitized and used to generate the final image. Spatial resolution in these images is decreased due to the inherent multi-directional scattering properties of light. A "direct" radiography detector employs a method in which a special semiconductor (for example, a photoconductor) material is used as the X-ray absorption material. In a process known as *direct conversion*, charges are generated by the X-ray interactions in the semiconductor and are collected and converted to a digital signal. Refer to Figure 2-4. The advantage of this process is that there is no need to produce an intermediate, resolution-degrading signal, such as light.

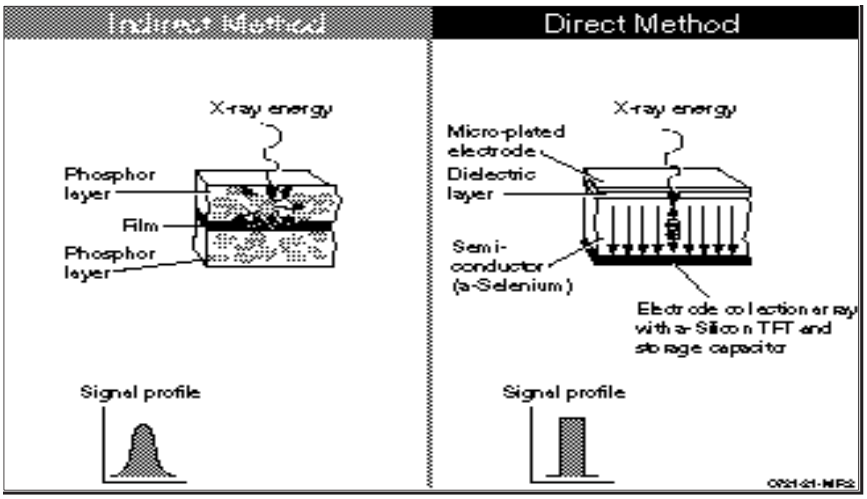


Figure 2-4. *Comparison of Indirect and Direct X-ray Capture Methods.*

Direct Radiography Corp., a wholly-owned subsidiary of Hologic, Inc., has developed a direct conversion approach using a-Se and TFTs. The DirectRay Detector is configured to include a dielectric layer between the a-Se and the top electrode to prevent the breakdown of the electric field across the selenium when charges (for example, electron-hole pairs) are produced.

The DirectRay Detector

The DirectRay Detector, illustrated in Figure 2-5, directly converts the X-rays to digital data. The DirectRay Detector has several layers. The first layer inside the cover, the SE-TFT detector matrix, converts the X-rays to digital data.

The DirectRay Detector also contains the control electronics and the precision analog electronics that perform the data capture and conversion into digital format. An 8-bit micro-controller in the DirectRay Detector performs the management functions of setup, monitoring, and control of the acquisition electronics.

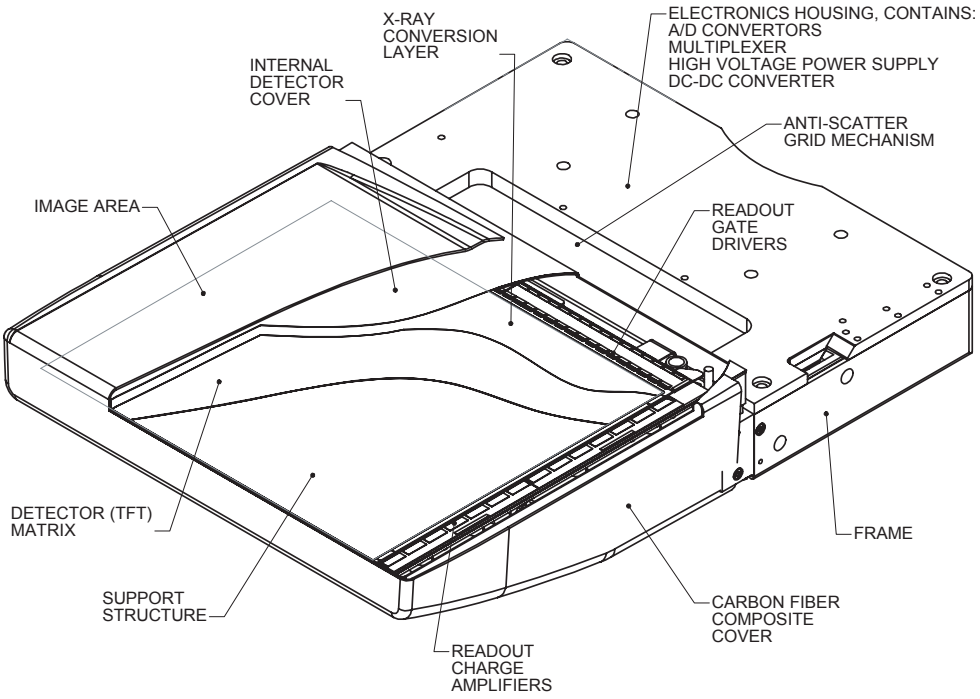


Figure 2-5. *DirectRay Detector Structure*

Layer Structure

The structural foundation of the DirectRay Detector is a rigid sheet of glass onto which is formed a detector element matrix using standard thin-film Active-Matrix Liquid Crystal Display (AMLCD) manufacturing techniques. As illustrated in Figure 2-6, each detector element consists of a single-storage capacitor, charge-collection electrode and an amorphous silicon (TFT) field-effect transistor (FET) switch. The gate of each FET is connected to one of a set of gate lines and the source of each FET is tied to one of a set of data lines.

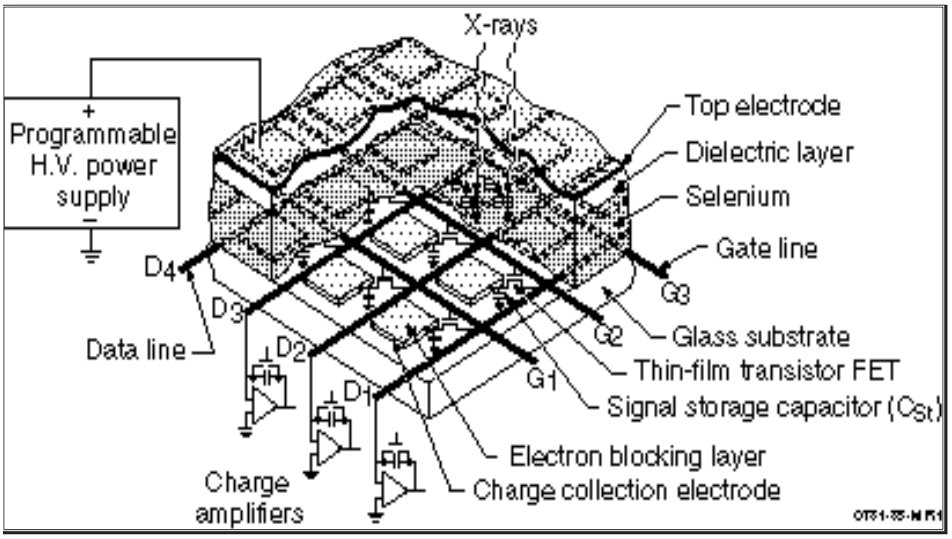


Figure 2-6. *Perspective View of DirectRay Detector Multi-Layer Structure*

The storage capacitor and charge-collection electrode are configured in such a way that the electrode forms a “mushroom head” over much of the detector element area. This unique design is illustrated in Figure 2-7 on page 2-11. The “mushroom” electrode:

- Shields the FET from the high electric field that is generated by the high voltage applied to the top electrode
- Shields the FET from signal charges that would collect on the insulation above the FET
- Increases the charge collection efficiency of each detector element by maximizing its area

In the configuration shown in Figure 2-7, the mushroom electrode covers 86% of the total detector element area. The mushroom electrode material blocks the electrons from injecting into the X-ray absorber above.

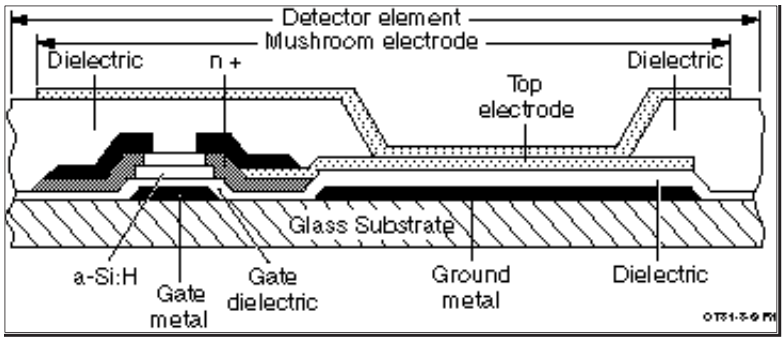


Figure 2-7. *Cross-Sectional View of the "Mushroom" Charge-Collection Electrode*

The layer above the detector element array is the actual X-ray conversion material. To achieve sufficient X-ray absorption, a thickness of 500 μm of a-Se is used. This material has been widely used in xeroradiography, so its electrical properties and vacuum deposition processes are well understood.

The next layer is an insulating material with a high dielectric strength. Thickness uniformity, good adhesion to selenium, optical transparency, and a low defect count to avoid high field breakdowns are some key requirements for this dielectric blocking layer.

A thin layer of metal is subsequently deposited on the dielectric material, serving as an electrode to which several kV can be applied to separate the electron-hole pairs. An additional material is deposited on top of the electrode material to environmentally isolate the detector.

Electronic Readout

The readout of the charges starts immediately at the end of the X-ray exposure. While all FETs (which are operated here as simple on–off switches) are not conducting during the X-ray exposure, a positive gate pulse applied to the first gate line simultaneously turns on all FETs connected to the first gate line. This causes the image charge to flow to a bank of charge amplifier modules connected to the data lines. The net X-ray signal is multiplexed and shifted out to a 14-bit analog-to-digital converter (ADC) and subsequently stored in computer memory. The readout of the charges continues row by row until the digital value of the charge in each storage capacitor has been transferred to memory. At the end of the readout cycle, a charge erase cycle is initiated to refresh the detector panel for the next exposure.

The current commercial 139-μm pitch DirectRay Detector has approximately 8 million pixels in the detector element matrix and a readout time of 4 seconds. Once in computer memory, the image data can be processed and displayed on a video monitor or routed into a network system.

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3

Installation

This chapter explains how to install the DirectRay components: the Detector, the Power and X-ray Control Module (PXCM), and the Interface PCI card.

Installation should be performed in the following sequence:

1. Unpack the DirectRay components.
2. Install the DirectRay Detector in the bucky and the PXCM in the X-ray tower.
3. Connect the PXCM to the Detector, using the appropriate cable.
4. Connect the PXCM to the Generator, using the appropriate cable.
5. Install the DirectRay Interface PCI card in the Acquisition Workstation, then connect the PXCM to the Interface card using fiber optic cable.
6. Calibrate the Automatic Exposure Control (AEC).

Guidelines for installing the DirectRay hardware components are included in this chapter. For instructions on calibrating the AEC, refer to Chapter 4.

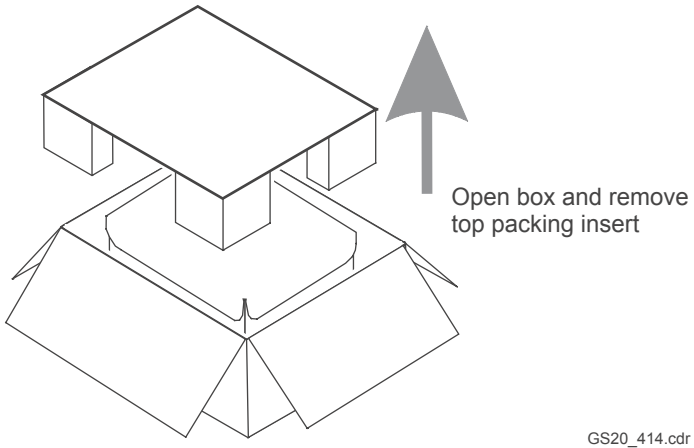
Unpacking the DirectRay Hardware Components

Unpacking the DirectRay Detector

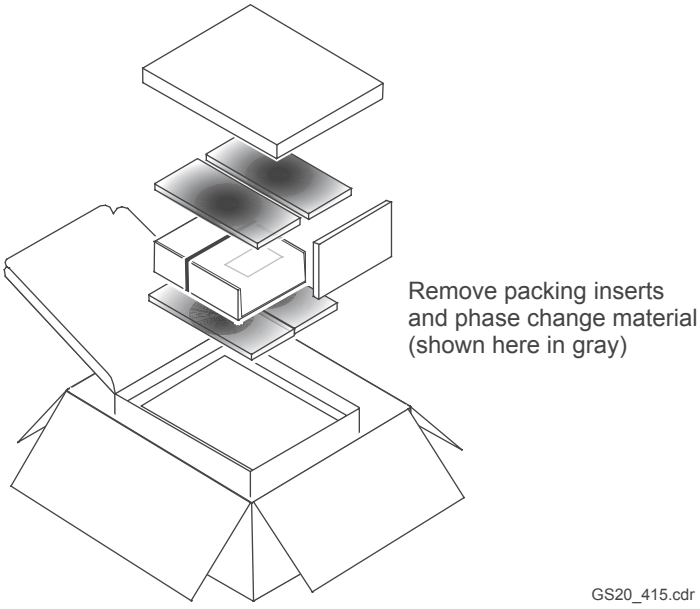
NOTE: *Save all packing materials, in case you need to return the DirectRay Detector to Direct Radiography Corp.*

To unpack the DirectRay Detector:

1. Open the box and remove the packing insert.



2. Remove all of the other packing material covering the inner box in which the Detector is packaged.



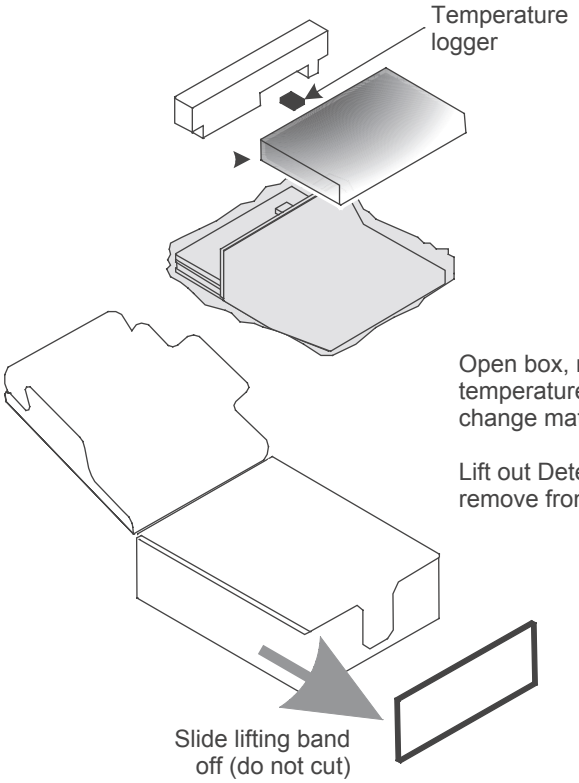
3. Lift the inner box from the large box by pulling up on the lifting band.

Lift out inner box
by pulling
on lifting band
(do not cut the band)

GS20_416.cdr

NOTE: Do not cut the lifting band.

4. Slide the lifting band from the inner box.



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5. Remove the packing material inside the inner box, which includes the temperature logger that is used to ensure that the Detector maintained the proper temperature will being shipped and stored.

6. Carefully remove the Detector from its protective bag.

CAUTION Handle the Detector with extreme care! Avoid touching the thin film top cover that protects the imaging area. The imaging electronics under the front cover are extremely sensitive. The actual image area starts at the front edge and is approximately 25 mm inside the other three edges. Any dust or fingerprints in this area may affect final image quality. Temperature extremes may cause permanent damage.

7. Save all packing material.

Hardware Installation Information

DirectRay Detector Installation

Install the DirectRay Detector in the mammography equipment using four M6 threaded fasteners.

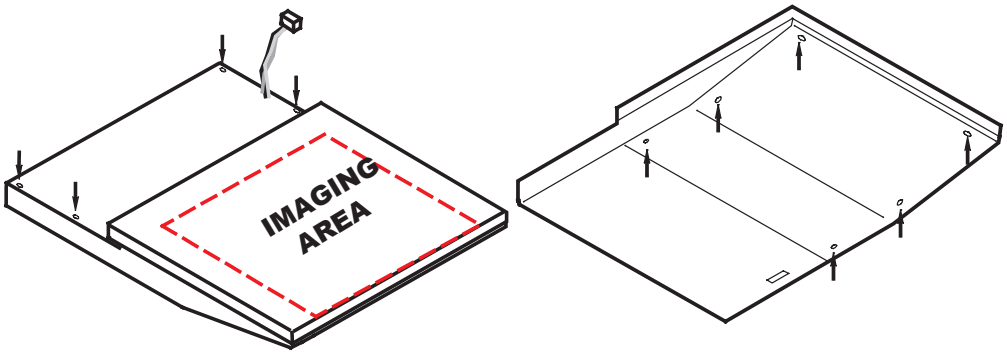


Figure 3-1. *DirectRay Detector Fastener Hole Locations*

Figure 3-2 shows the Detector connector used for the cable that connects the Detector to the DirectRay PXCM.

Figure 3-2. *DirectRay Detector Connector (for cable to PXCM)*

DirectRay PXCM Installation

Mount the DirectRay PXCM in the mammography equipment on four size M4 studs, in the position indicated in Figure 3-3.

NOTE: *To ensure reliable communications, keep the fiber optic connections covered by protective caps when not in use.*

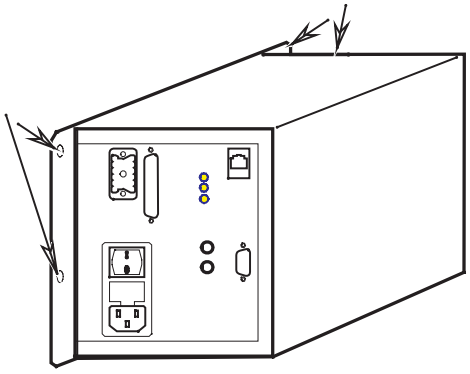


Figure 3-3. *DirectRay PXCM Stud Hole Locations*

Figure 3-4 shows the PXCM connectors used for the cable that connects the Detector to the DirectRay PXCM, and the fiber optic cable to the DirectRay Interface card.

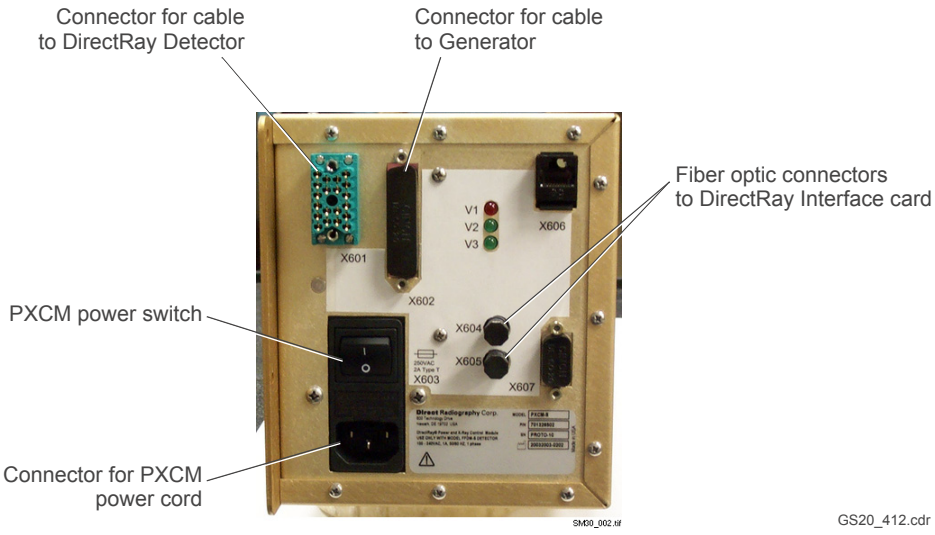
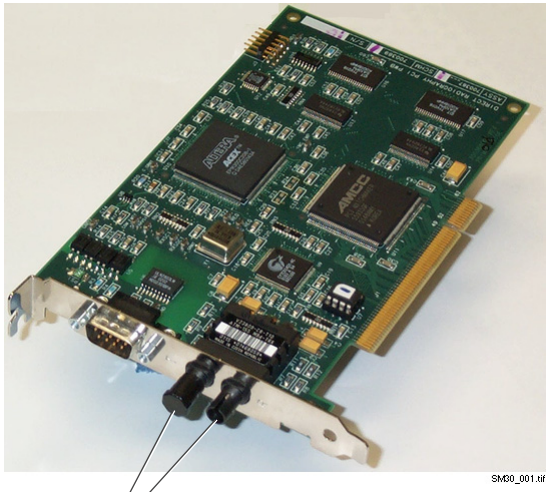


Figure 3-4. *DirectRay PXCM Connectors (for cable to Detector and fiber optic cables to Interface card)*

DirectRay Interface Card Installation

The DirectRay Interface card is PCI-bus compatible, and uses a standard PCI card install procedure. For installation instructions, refer to the hardware installation instructions that accompany the Acquisition Workstation.

Figure 3-5 shows the Interface card fiber optic connectors used for the cable that connects the PXCM to the Interface card.



Connectors for fiber optic cables to DirectRay PXCM (shown with cap on left connector)

GS20_413.cdr

Figure 3-5. *DirectRay Interface Card Fiber Optic Connectors (for fiber optic cable to PXCM)*

Fiber Optic Cable Installation and Care Guidelines

Handling

- Always handle fiber optic cables delicately and by the connector housing.
- Avoid acute bends in the cable, as this could break the fiber optic link inside the cable.

Connecting

- Always perform one connection at a time.
- Remove the dust caps on the fiber optic connectors (you may have to rotate the cap to loosen it).
- Holding the cable by the connector housing, insert the cable connector into the connector on the device, making sure to align the keying features so the connectors are properly mated, then turning the connector clockwise to lock it.
- To disconnect the cable connector, turn it counterclockwise, then pull it from the connector on the device.

Cleaning

- Clean the connectors on both the cable and the devices with a lint-free, alcohol-dampened cloth.
- Thoroughly wipe the side and end of the ferrule.
- Blow the ferrule with compressed air, or allow it to air dry, before reconnecting the cable.
- Visually inspect the ferrule for lint.
- When not connected, replace the protective cap onto connector ends.

4

Calibrating the AEC

This chapter describes how to calibrate the AEC by generating a goal table for a desired target/filter combination and loading it into the DirectRay Power and X-ray Control Module (PXCM).

You use the AEC Calibration Tool to perform the calibration.

When AEC Calibration Should Be Performed

AEC calibration should be performed:

- As part of the initial system installation.
- Once a year.
- If changes are made to any of the DirectRay components or the Generator (for example, if the PXCM is replaced).

The Three Calibration-Related Procedures

The purpose of the AEC calibration is to determine a valid mAs value and, using that value, take a series of exposures to generate goal images. The AEC Calibration Tool averages the goal images to, in turn, generate and load a goal table into the PXCM.

There are three calibration procedures, which are performed in sequence:

1. Determining the Half Value Layer (HVL) of the X-ray Generator for a given target/filter combination (described in “Determining the Half Value Layer (HVL)” on page 4-5).
2. Using the HVL, determine the Entrance Skin Exposure (ESE; described in “Determining the Entrance Skin Exposure (ESE)” on page 4-8). The resulting mAs value is used during the goal image exposure, in the next procedure.
3. Using the mAs value determined in the ESE procedure, generating the goal image (described in “Generating the Goal Image” on page 4-11), which results in a goal table being loaded into the PXCM.

Note that, if you know the correct HVL value, derived by running the Determine HVL procedure previously, you can skip that procedure and go right to the Determine ESE procedure. Likewise, if you know the valid mAs to use during the "goal image" exposures, you can skip the Determine ESE procedure and go right to the Generate Goal procedure.

Starting the AEC Calibration Tool

Before starting the AEC Calibration Tool:

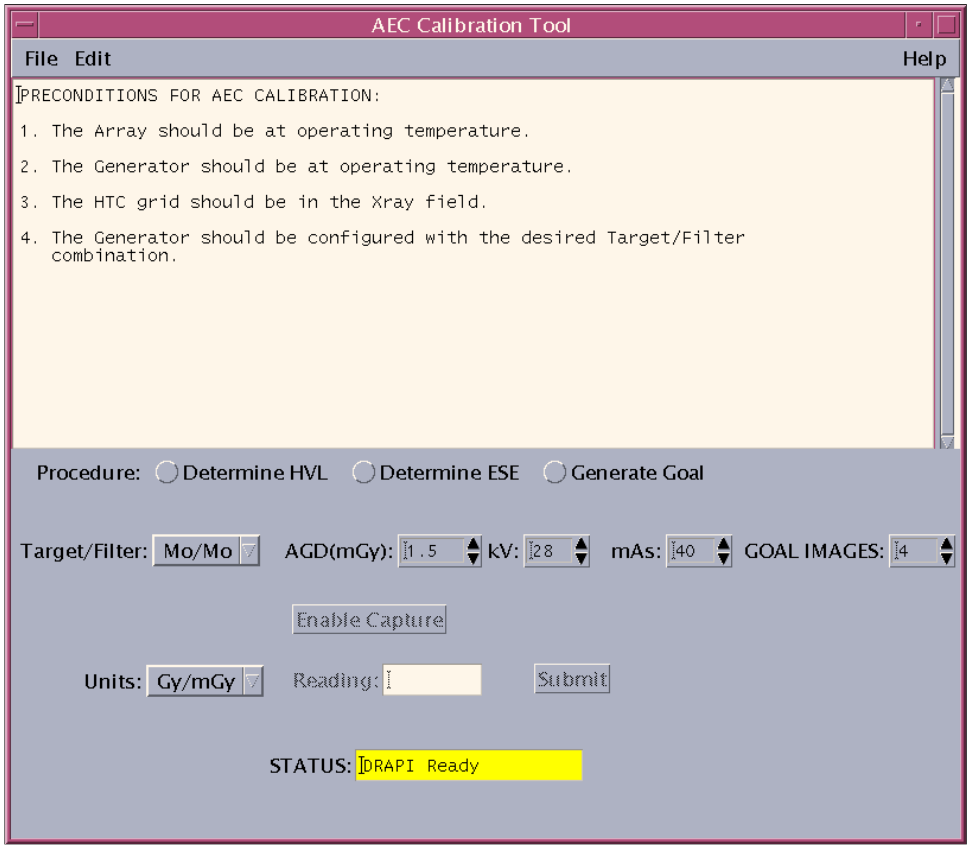
- You must be logged in to the FFDM-S Acquisition Workstation operating system as **apps**.
- The FFDM-S Acquisition Workstation application must not be running.

  If the application is running, kill it using the task manager.

  *If you are logging in as **apps**,* then immediately upon the desktop being displayed, double-click the console window icon and press the Ctrl+C keys. You must do this within 5 seconds to prevent the FFDM-S Acquisition Workstation application from starting.

To start the AEC Calibration Tool, in a terminal window, enter the command **AecCalTool**.

You should see progress information in the terminal window. Eventually, the AEC Calibration Tool main window will open. The main window will finish displaying when the DRAPI initialization is complete.

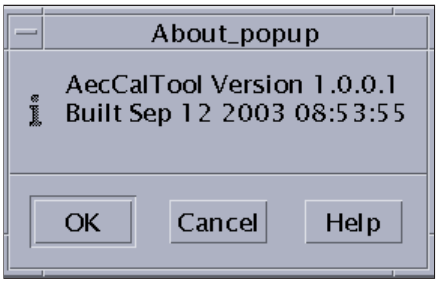


Note that the window image above shows the default configuration of the tool:

- Target/filter setting is Mo/Mo
- Units are set to Gy/mGy
- AGD is set to 1.5 mGy
- No procedure active

Viewing Version Information and Exiting the Tool

To view the tool's version and build information, open the **Help** menu and choose **About**. The About dialog box displays.



To exit the tool, open the **File** menu and choose **Quit**.

Main Window Functions and Options

The AEC Calibration Tool window's functions and options are described in Table 4-1.

Table 4-1. AEC Calibration Tool Functions and Options

Function/Option	Description
Procedure Options	You choose what procedure you want to perform from these three options. Only one can be selected at a time. When the tool starts, no procedure is selected. You must select one of the three procedures to continue. • **Determine HVL.** Select this procedure to determine the Half Value Layer (HVL) of the X-ray Generator for a given target/filter combination. For the procedure for determining the HVL, refer to "Determining the Half Value Layer (HVL)" on page 4-5. • **Determine ESE.** Select this procedure to determine the Entrance Skin Exposure (ESE). This step may be performed without determining the HVL of the X-ray Generator. However, a valid HVL value must be known. For the procedure for determining the ESE, refer to "Determining the Entrance Skin Exposure (ESE)" on page 4-8. • **Generate Goal.** Select this procedure to generate the goal table for the selected target/filter combination. This step may be performed without determining the HVL of the X-ray Generator or the ESE. However, a valid mAs value must be known. For the procedure for generating the goal, refer to "Generating the Goal Image" on page 4-11.
Target/Filter	The desired target/filter combination. The goal table will be named to match (Mo/Mo is goaltab1, Mo/Rh is goaltab2, W/Rh is goaltab3). Make sure that the Generator setting matches this selection. Since this selection determines future instructions and calculations, this selection will be disabled once the first HVL exposure is taken.

Table 4-1. AEC Calibration Tool Functions and Options (cont.)

Function/Option	Description
AGD	Use this to select the desired Average Glandular Dose to be used in calculating the mAs value for calibration. In a future version, this value will be logged on the end of the goal table file. The default is 1.5 mGy (150 mR).
kV	Use this to indicate the kV to be used during the calibration. This selection in the AEC Calibration Tool window does not actually change the Generator settings, but is intended to serve as a reminder to the user what the current Generator settings are. The default is 28 kV.
mAs	Use this to indicate the mAs to be used during the calibration. This selection in the AEC Calibration Tool window does not actually change the Generator settings, but is intended to serve as a reminder to the user what the current Generator settings are.
Goal Images	Use this to select the number of goal images to be taken and averaged together to create the goal table. Select 1 to 4 images.
Enable Capture button	Use this to enable the DRAPI for image capture. If the Status Window is green and displays “DRAPI Armed”, it is not necessary to use this button. This button will only work when the status window is yellow and displays “DRAPI Ready”. Clicking on this button will clear the Radiation Entry field.
Units	Use this to select the radiation units to be used. Choices are R/mR or Gy/mGy. When this selection is changed, the AGD setting will change to convert the value to the current units. The display in the instructions field after each exposure will also report in the selected units.
Reading	Use this field to enter the dosimeter reading as instructed following each exposure for HVL or ESE determination. Enter the numerical characters in the field and click the **Submit** button. The last entry will be cleared whenever the **Enable Capture** button is pressed.
Submit button	Use this button to submit a radiation entry.
Status	• “DRAPI Not Ready” (white). The DRAPI is processing the previous exposure. • “DRAPI Ready” (yellow). The DRAPI is ready to be enabled for exposure. • “DRAPI Armed” (green). The DRAPI is ready for exposure. Press the Generator exposure buttons to expose.

Determining the Half Value Layer (HVL)

Select the **Determine HVL** procedure option if you need to determine the HVL of the X-ray Generator for a given target/filter combination.

This procedure requires taking four exposures.

- The first exposure and the last exposure are “control” exposures with no attenuating material in place.
- The second exposure is taken with Aluminum in the path of the X-ray beam. For the Molybdenum target, use a 0.3-mm thickness of Aluminum. For the Tungsten target, use a 0.4-mm thickness of Aluminum.
- The third exposure is taken with a thicker amount of Aluminum in the path of the X-ray beam.
  - For the Molybdenum target and Molybdenum filter, use a 0.4-mm thickness of Aluminum.
  - For the Molybdenum target and Rhodium filter, use 0.5-mm.
  - For the Tungsten target and Rhodium filter, use a 0.6-mm thickness of Aluminum.

The result of the HVL procedure is a fractional number representing the HVL in millimeters of Aluminum.

NOTE: *If you already know the HVL and want to proceed with determining the ESE value, go to* *“Determining the Entrance Skin Exposure (ESE)” on page 4-8.*

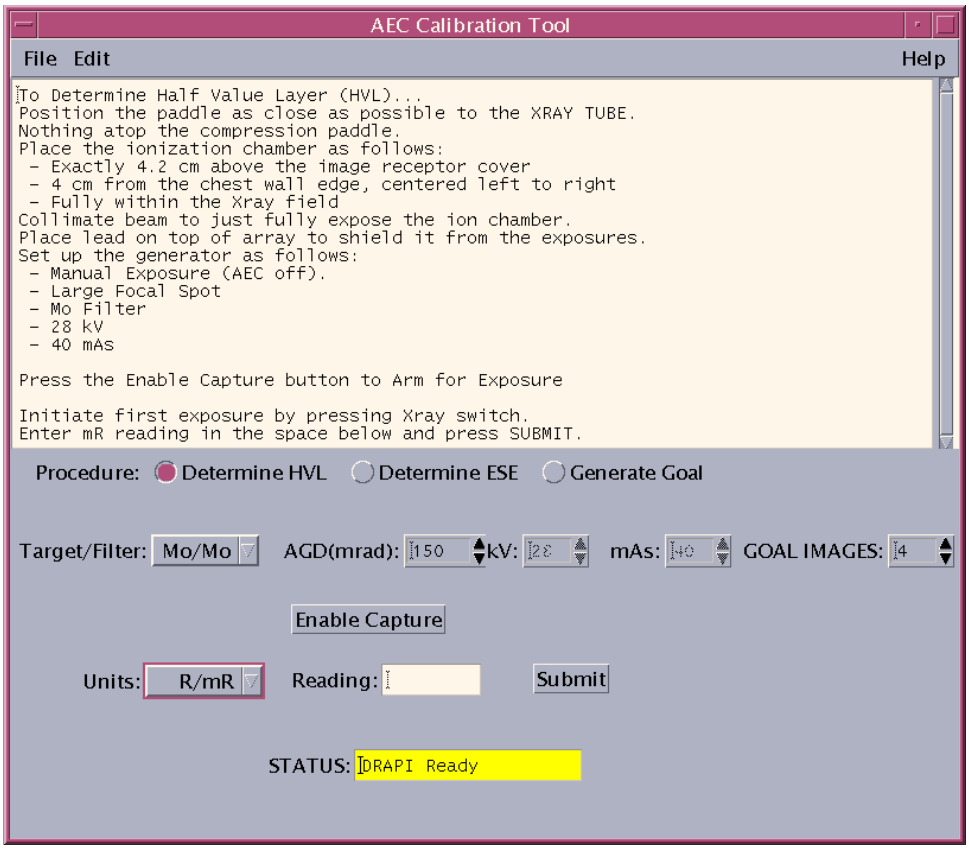
To determine the HVL value:

1. In the tool’s main window, select the **Determine HVL** procedure option.

   In the main window, the settings change and instructional text is displayed:

   - The HVL procedure has been selected
   - The units have been changed to R/mR
   - The default AGD is now displayed in mrad instead of mGy
   - Instructions for Generator and dosimeter configuration are displayed in the text window

   An example of the main window with the **Determine HVL** procedure option selected is shown below.


AEC Calibration Tool
File Edit
Help
To Determine Half Value Layer (HVL)...
Position the paddle as close as possible to the XRAY TUBE.
Nothing atop the compression paddle.
Place the ionization chamber as follows:
- Exactly 4.2 cm above the image receptor cover
- 4 cm from the chest wall edge, centered left to right
- Fully within the Xray field
Collimate beam to just fully expose the ion chamber.
Place lead on top of array to shield it from the exposures.
Set up the generator as follows:
- Manual Exposure (AEC off).
- Large Focal Spot
- Mo Filter
- 28 kV
- 40 mAs
Press the Enable Capture button to Arm for Exposure
Initiate first exposure by pressing Xray switch.
Enter mR reading in the space below and press SUBMIT.
Procedure: Determine HVL Determine ESE Generate Goal
Target/Filter: Mo/Mo AGD(mrad): 150 kV: 28 mAs: 40 GOAL IMAGES: 4
Enable Capture
Units: R/mR Reading: Submit
STATUS: DRAPI Ready

2. Once the setup is complete, click the **Enable Capture** button.

   The Status message changes from “DRAPI Ready” to “DRAPI Armed” and turns from yellow to green.

3. Make sure the Generator is configured properly, then make the indicated exposure.

4. Select the desired units.

5. In the **Reading** field, enter the dosimeter value in the appropriate units: mR (milliRoentgen) or mGY (milliGray).

6. Make sure the entry is correct, then click the **Submit** button.

   As the DirectRay Detector and DRAPI recycle for the next exposure, the Status will change from “DRAPI Armed” to “DRAPI Not Ready” and will turn from green to white.

   When the DRAPI is ready to be enabled for the next exposure, the Status will again say “DRAPI Ready” and will be yellow. Instructions for the next exposure display.

7. Perform the displayed instructions.

   The amount of aluminum added in this step is dependent on the target/filter selection (Mo/Mo = 0.3mm; Mo/Rh = 0.3mm; W/Rh = 0.5mm).

8. Click the **Enable Capture** button.

   The last dosimeter reading you entered is cleared. The status window will change from “DRAPI Ready” to “DRAPI Armed” and will turn from yellow to green.

9. Make sure the Generator is configured properly and make the indicated exposure.
10. In the **Reading** field, enter the dosimeter value in the appropriate units
11. Make sure the entry is correct, then click the **Submit** button.

    When the DRAPI is ready to be enabled for the next exposure, the Status will again say "DRAPI Ready" and will be yellow. Instructions for the next exposure display.
12. Perform the displayed instructions.

    The total thickness of aluminum in this step is dependent on the target/filter selection (Mo/Mo = 0.4mm; Mo/Rh = 0.5mm; W/Rh = 0.6mm).
13. Click the **Enable Capture** button.

    The last dosimeter reading you entered will be cleared. The Status will change from "DRAPI Ready" to "DRAPI Armed" and will turn green.
14. Make sure the Generator is configured properly and make the indicated exposure.
15. In the **Reading** field, enter the dosimeter value in the appropriate units
16. Make sure the entry is correct, then click the **Submit** button.

    When the DRAPI is ready to be enabled for the next exposure, the Status will again say "DRAPI Ready" and will be yellow. Instructions for the final HVL exposure step display.
17. Perform the displayed instructions.
18. Click the **Enable Capture** button.

    The last dosimeter reading you entered will be cleared. The status window will change from "DRAPI Ready" to "DRAPI Armed" and will turn Green.
19. Make sure the Generator is configured properly and make the indicated exposure.
20. In the **Reading** field, enter the dosimeter value in the appropriate units
21. Make sure the entry is correct, then click the **Submit** button.

    The calculated Half Value Layer value is computed and displayed. The tool stores this value internally, to be used as input to the ESE procedure.

NOTE: *You may want to make a note of the HVL value, so that you can skip the HVL procedure and go right to the ESE procedure in future calibrations.*

Determining the Entrance Skin Exposure (ESE)

You select the **Determine ESE** procedure option if you need to determine a valid mAs to use when generating a goal image.

NOTE: *If you already know the valid mAs to use and want to proceed to generating the goal image, go to "Generating the Goal Image" on page 4-11.*

The ESE procedure requires the HVL. If the HVL procedure has already been performed, the tool will already have the HVL value. If you are skipping the HVL procedure and starting with the ESE procedure, a dialog box displays, prompting you to enter the HVL value.

The ESE procedure involves taking three exposures. The dosimeter readings for each exposure are averaged together to determine the ESE for the selected Average Glandular Dose (AGD). This in turn suggests the mAs that should be used to generate the goal table.

To determine the mAs value:

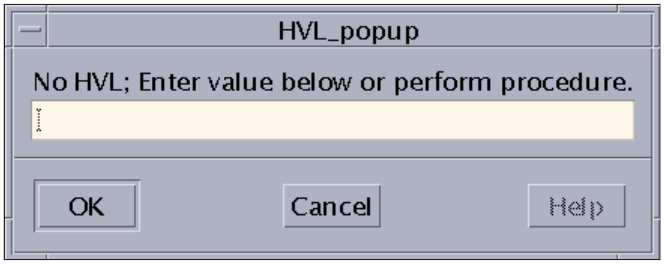
1. In the tool's main window, select the desired AGD value before starting the ESE determination.

   Once the first ESE exposure has been performed, the AGD value cannot be changed.

2. Select the **Determine ESE** procedure option.

   If the tool has the HVL value stored internally (for example, you just performed the HVL procedure), go to step 5.

   If the tool does not have the HVL value, the HVL Popup dialog box displays.



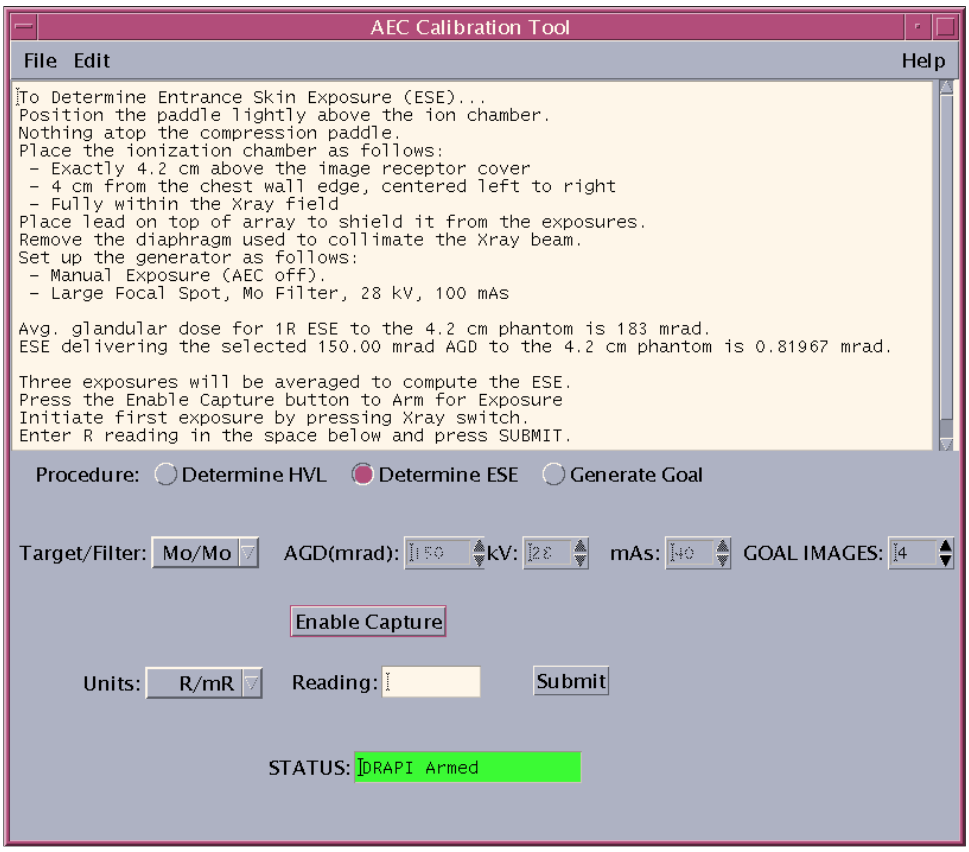
3. ***If you know the HVL value,*** enter the fractional value (for example, 0.3611), then click **OK** or press the ENTER key.

   If you do not know the HVL value, refer to "Determining the Half Value Layer (HVL)" on page 4-5.

4. After entering the HVL value, select the **Determine ESE** procedure option again.

   In the main window, the settings change, based on the HVL and the selected AGD, and instructional text is displayed.

   Note that the Status field turns green and displays the message "DRAPI Armed."

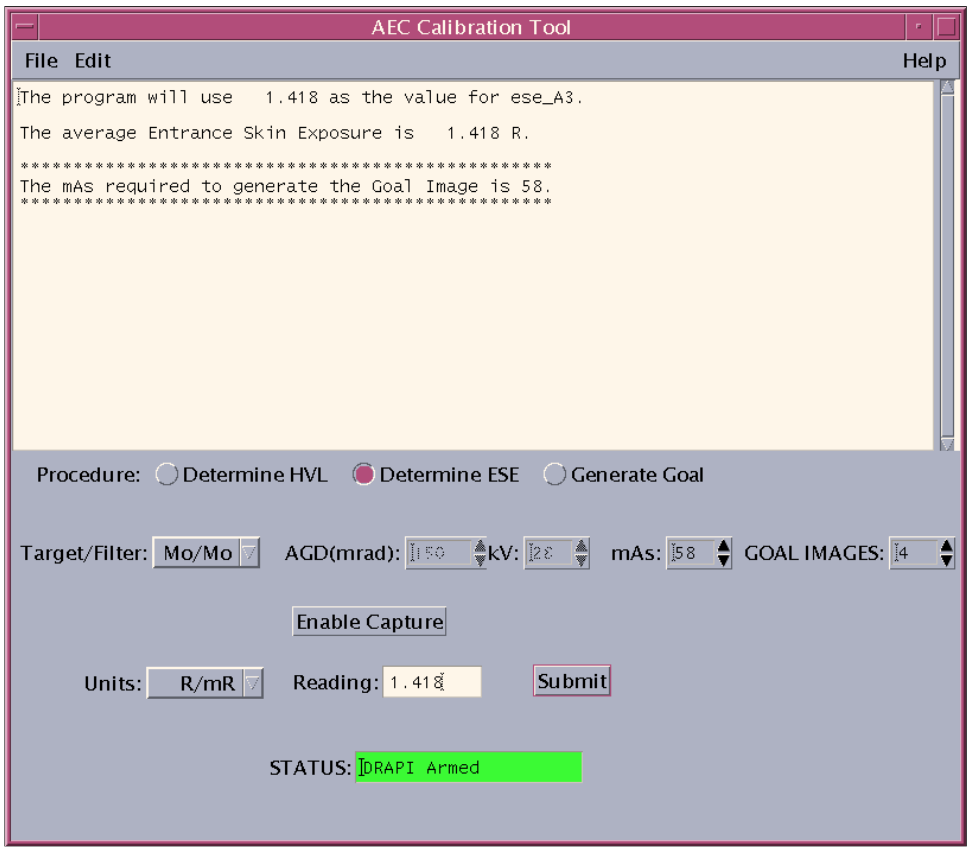

AEC Calibration Tool
File Edit
Help
To Determine Entrance Skin Exposure (ESE)...
Position the paddle lightly above the ion chamber.
Nothing atop the compression paddle.
Place the ionization chamber as follows:
- Exactly 4.2 cm above the image receptor cover
- 4 cm from the chest wall edge, centered left to right
- Fully within the Xray field
Place lead on top of array to shield it from the exposures.
Remove the diaphragm used to collimate the Xray beam.
Set up the generator as follows:
- Manual Exposure (AEC off).
- Large Focal Spot, Mo Filter, 28 kV, 100 mAs
Avg. glandular dose for 1R ESE to the 4.2 cm phantom is 183 mrad.
ESE delivering the selected 150.00 mrad AGD to the 4.2 cm phantom is 0.81967 mrad.
Three exposures will be averaged to compute the ESE.
Press the Enable Capture button to Arm for Exposure
Initiate first exposure by pressing Xray switch.
Enter R reading in the space below and press SUBMIT.
Procedure:
Determine HVL
Determine ESE
Generate Goal
Target/Filter:
Mo/Mo
AGD(mrad):
kV:
mAs:
GOAL IMAGES:
Enable Capture
Units:
R/mR
Reading:
Submit
STATUS:
DRAPI Armed

5. Click the **Enable Capture** button, then make the indicated exposure.
6. Enter the dosimeter reading in the appropriate units.

   Note that the scale of the units to be entered changes from mR to R if the **R/mR** units are selected, but remains in mGy if **Gy/mGy** units are selected.
7. Repeat steps 5 and 6 for the second and third ESE exposures.

   After the third exposure, the average of the three dosimeter values entered is displayed. Also, the suggested mAs value to be used for goal table generation. is displayed.

NOTE: *In most cases, the suggested mAs will not exactly match an mAs value to which the Generator can be set. In this case, it is recommended that you use the closest lower mAs setting so that the desired AGD will not be exceeded during future AEC exposures.*


AEC Calibration Tool
File Edit
Help
The program will use 1.418 as the value for ese_A3.
The average Entrance Skin Exposure is 1.418 R.
****
The mAs required to generate the Goal Image is 58.
****
Procedure: Determine HVL Determine ESE Generate Goal
Target/Filter: Mo/Mo
AGD(mrad): 150
kV: 28
mAs: 58
GOAL IMAGES: 4
Enable Capture
Units: R/mR
Reading: 1.418
Submit
STATUS: DRAPI Armed

Generating the Goal Image

You use the Generate Goal procedure to generate the goal table for the selected target/filter combination.The goal table will be created for the mAs value used by the Generator to create the goal images.

Before performing the Generate Goal procedure, you must have a valid mAs value. If you do not know a valid mAs value, you can perform the HVL and ESE procedures to determine it. Refer to “Determining the Half Value Layer (HVL)” on page 4-5 and “Determining the Entrance Skin Exposure (ESE)” on page 4-8.

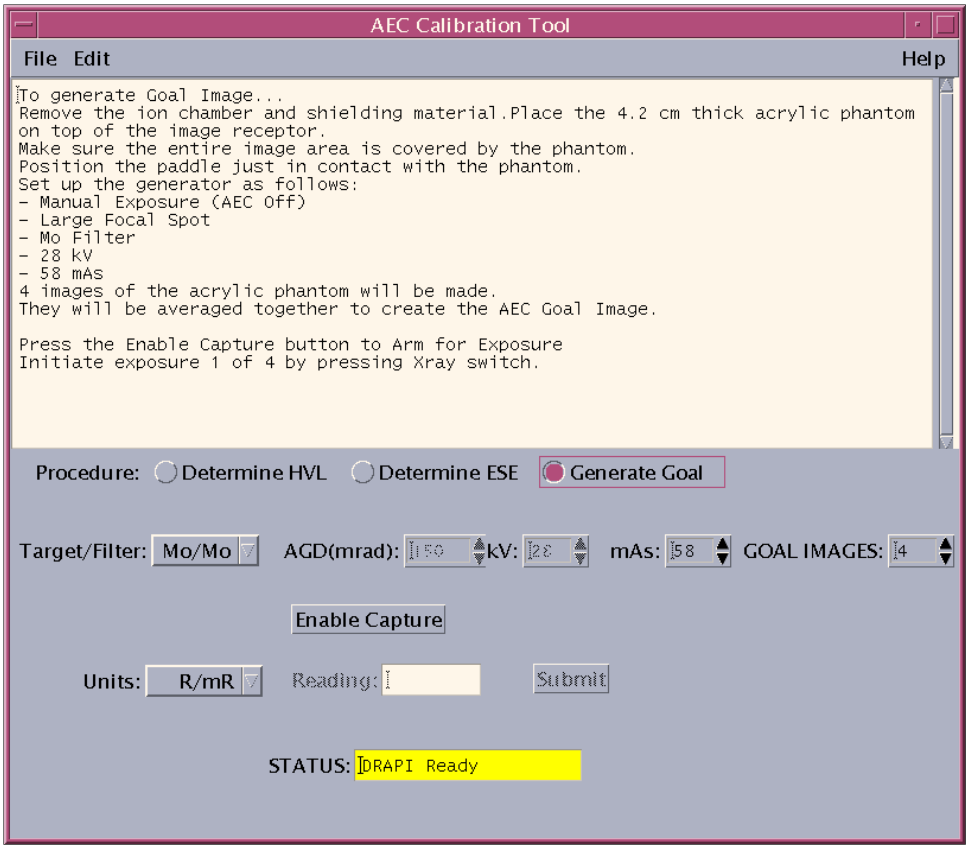
During the procedure, you will choose the number of goal images (1 to 4) to average together for the final result. The tool instructions will prompt you to enable capture and expose for each of the images. When the final image exposure is complete, the tool will automatically generate the goal table with a name derived from the target/filter combination used. The goal table will then automatically be loaded to the DirectRay PXCM.

To generate the goal image:

1. In the tool’s main window, select the **Generate Goal** procedure option

NOTE: *You can select the* ***Generate Goal*** *option without performing the Determine HVL and Determine ESE procedures, provided you know the proper mAs to configure the Generator.*

In the main window, the settings change and instructional text is displayed.


AEC Calibration Tool
File Edit
Help
To generate Goal Image...
Remove the ion chamber and shielding material.Place the 4.2 cm thick acrylic phantom on top of the image receptor.
Make sure the entire image area is covered by the phantom.
Position the paddle just in contact with the phantom.
Set up the generator as follows:
- Manual Exposure (AEC Off)
- Large Focal Spot
- Mo Filter
- 28 kV
- 58 mAs
4 images of the acrylic phantom will be made.
They will be averaged together to create the AEC Goal Image.
Press the Enable Capture button to Arm for Exposure
Initiate exposure 1 of 4 by pressing Xray switch.
Procedure: Determine HVL Determine ESE Generate Goal
Target/Filter: Mo/Mo
AGD(mrad): 150
kV: 28
mAs: 58
GOAL IMAGES: 4
Enable Capture
Units: R/mR
Reading:
Submit
STATUS: DRAPI Ready

2. Select the desired number of Goal Images to average (1 to 4) before taking the first exposure.
3. Follow the displayed instructions for Generator configuration.

   Note that if you just finished the ESE determination, the suggested mAs appears both in the text field and in the mAs field. This is intended to be only a reminder; you must manually set the proper mAS on the Generator.
4. Click the **Enable Capture** button, then make the indicated exposure.

   Part of the text scrolling in the initial command window will show "Writing image to file GOAL1.img" and then "Done writing file."
5. If averaging more than one image, wait for the DRAPI to be ready again, then enable capture and expose again. Do this for each image to be included in the averaging.

   When the final image has been written to a file, the images will be averaged together (if more than one) and the goal table file will be generated. The file name for the goal table image is based on the target/filter selection (Mo/Mo = goaltab1; Mo/Rh = goaltab2; W/Rh = goaltab3).

   The text display changes to show the number of averaged images.

   The text scrolling in the initial command window will show the following text:

NOTE: *The text messages may be interspersed with DRAPI image frame messages. Also, the sample messages shown below represent a selected AGD of 1.5 mGy.*

```
Binning the goal image to make goaltab file goaltab1 for Mo/Mo target/filter.
Reading image file... done.
 Generating binned image
 done.
Writing AEC image (448x512) file... done.
Writing mem image (28x32) file... done.
Image binning complete.
Opening goaltab1 for goaltab input
Opening brick:/tmp/goaltab1 for goaltab output
Reading goaltab1 for goaltab input
Read 896 goaltab entries.
Closing goaltab1
Writing brick:/tmp/goaltab1 for goaltab output
Wrote 3584 bytes via rfs.
Writing the value "15" to brick:/tmp/goaltab1 for AGD output…
Wrote 4 bytes via rfs.
Closing brick:/tmp/goaltab1
Installing goaltab1 to long-term Brick configuration…
(/usr/local/bin/xrayconfig goaltab1 save /tmp/goaltab1)
"save" OK.
Installing goaltab1 to effective and short-term Brick configuration…
(/usr/local/bin/xrayconfig goaltab1 load /tmp/goaltab1)
"load" OK.
Goal Table goaltab1 successfully loaded on Brick.
************************************
AEC Calibration procedure is complete.
************************************
```

At this point, the system is ready to use in AEC mode.

There may be a problem loading the expanded goaltab file (3584 pixels plus 4-byte AGD value) into effective and short-term storage on the PXCM.

Alternatively, you may see the following output in the terminal window where you started the tool:

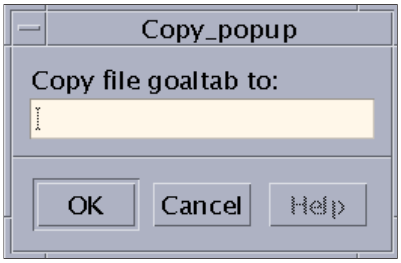
```
Installing goaltab to long-term Brick configuration...
(/usr/local/bin/xrayconfig goaltab save /tmp/goaltab)
 "save" OK.
Installing goaltab to effective and short-term Brick configuration...
(/usr/local/bin/xrayconfig goaltab load /tmp/goaltab)
*** Error 256 running rssio_exec for load.
**** unknown error
.SendGoalToBrick:Goal Table goaltab NOT loaded on Brick.
************************************
*** Error sending goaltab to brick.
************************************
```

If you see the "save OK" message but an error instead of the "load OK" message, be assured that the goaltab has been stored in the PXCM's long-term storage and will be auto-installed on reboot. Simply reboot the PXCM before attempting to take AEC exposures. For information on rebooting the PXCM, refer to "Rebooting the PXCM" on page 5-21.

Copying Goal Images

You can copy an existing goaltab file to the PXCM under another name.

To copy the goaltab file to the PXCM using a different name, open the **File** menu and choose **Copy**. The Copy Popup dialog box displays, indicating the name of the source goaltab file (this is the goaltab for Mo/Mo filter/target combination).



Enter the copy's name in the **Copy file goal tab to:** field, then click **OK**. The goaltab for Mo/Mo will be copied to a new file on the PXCM, using the file name you entered.

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5

PXCM Web Tool

This chapter describes tasks related to using the DirectRay Power and X-ray Control Module's (PXCM) Web Tool.

When PXCM Web Functions Should Be Used

Many of the PXCM Web Tool functions are intended for use only by Direct Radiography Corp., or only when Direct Radiography Corp.'s Support staff directs you to use them in the course of troubleshooting system problems.

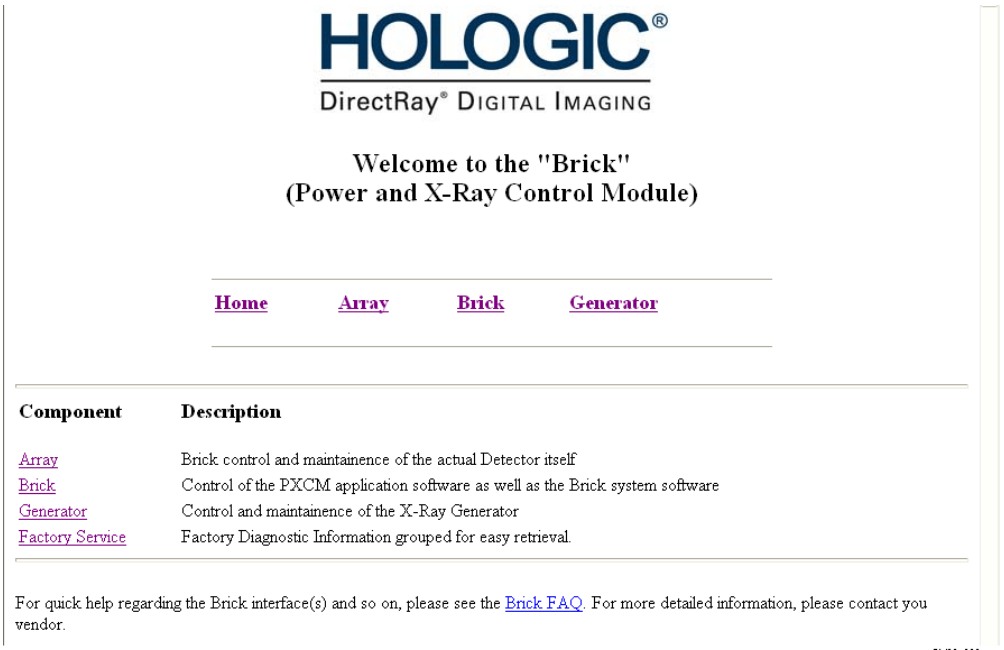
Restrictions regarding a function's use is covered in its topic in this chapter.

Opening the PXCM Web Tool Home Page

To open the PXCM Web Tool's home page, from a web browser running on the Acquisition Workstation, enter the following in the URL field:

http://brick

The PXCM home page displays.


HOLOGIC®
DirectRay® DIGITAL IMAGING
Welcome to the "Brick"
(Power and X-Ray Control Module)
Home
Array
Brick
Generator
Component
Description
Array
Brick control and maintainence of the actual Detector itself
Brick
Control of the PXCM application software as well as the Brick system software
Generator
Control and maintainence of the X-Ray Generator
Factory Service
Factory Diagnostic Information grouped for easy retrieval.
For quick help regarding the Brick interface(s) and so on, please see the Brick FAQ. For more detailed information, please contact you vendor.
SM00_200.png

Function Security Levels and Login Prompts

PXCM web tool functions are assigned one of three security levels. The security level is indicated in the Security panel at the top of each function's page:

Security: Low

Low security, indicated by a green background. These functions can be used without affecting the related component's operation.

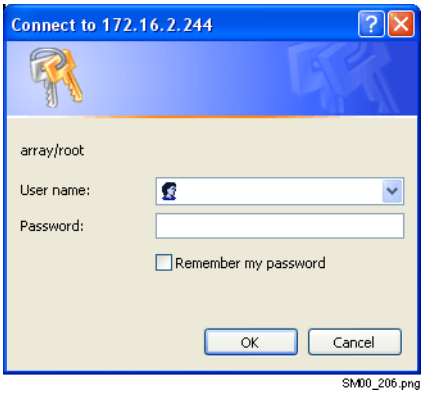
Security: Moderate

Moderate security, indicated by a yellow background. These functions could affect the related component's operation, but changes would not adversely affect its operation.

Security: High

High security, indicated by a red background. These functions could affect the related component's operation and, if not done properly, could adversely affect its operation.

Any time a user attempts to use a function assigned moderate or high security, a login prompt will be displayed, to verify that they have authority to use the function.



SM00_206.png

The login and password are:

login: **root**

password: **brick**

Once you have logged in to a particular function, you will not be prompted to log into that function again when attempting to use it during the same PXCM web tool session.

Detector Functions

NOTE: *The DirectRay Detector is also referred to as the "Array." Therefore, you will see the term "Array" used for "Detector" throughout the web tool and the topics in this chapter.*

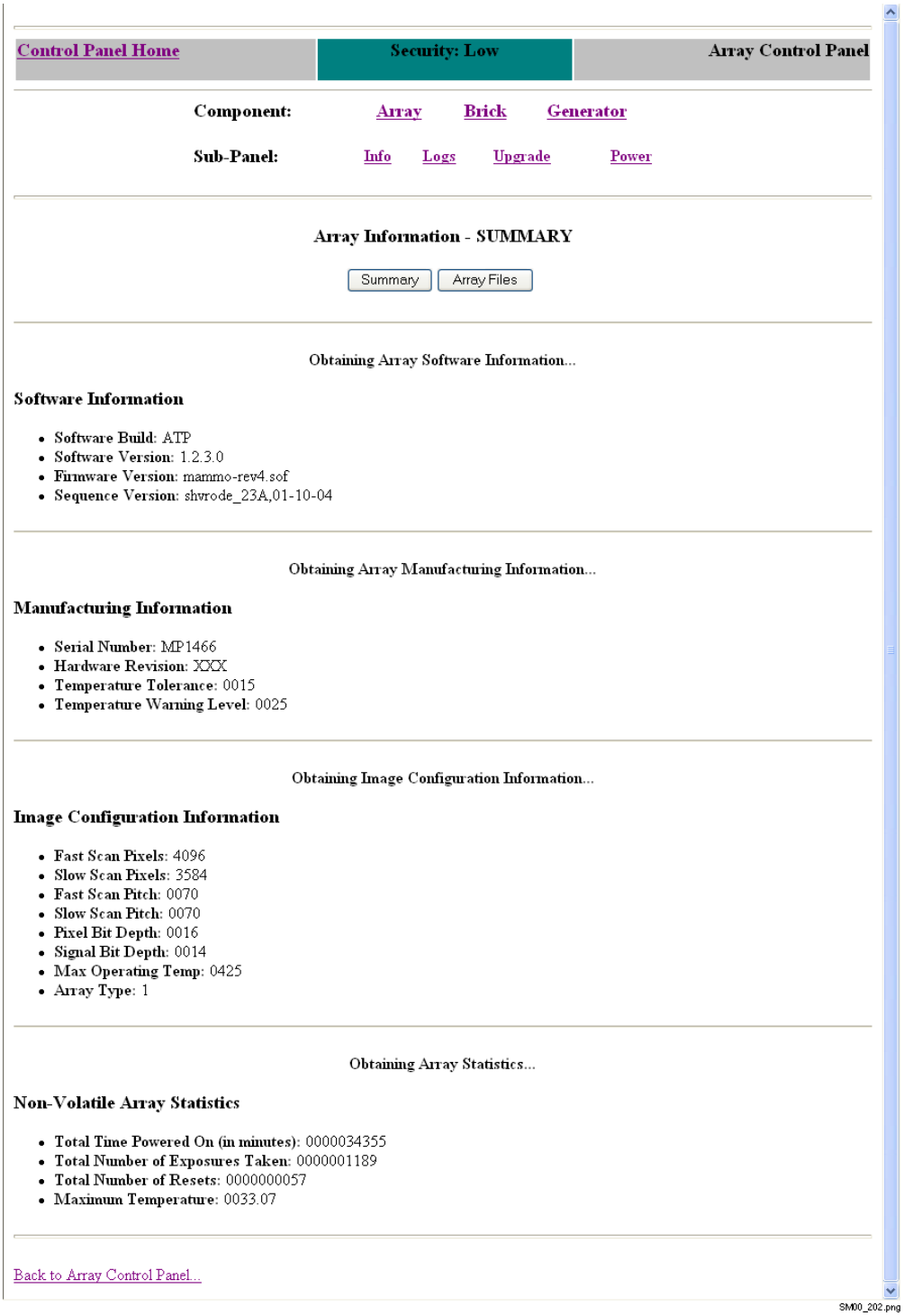
The Detector functions are accessible from the Array Control Panel page.

To display the Array Control Panel page, click either of the Array links on the home page.

SM00_201.png

Viewing Information About the Detector

To view information about the Detector, click the Information/Status link on the Array Control Panel page, or the Info link on any of the other Array pages. The Array Information - Summary page displays.



To view a listing of the Detector files, click the **Array Files** button. A list of Detector files displays, as shown below. Some file names are links; clicking on one of these links displays the contents of the file.

SM00_203.png

Viewing Detector Log Files

NOTE: *Detector log file information is intended as an aid to Direct Radiography Corp. Support staff in troubleshooting Detector problems. For this reason, you will typically be using this function only at the direction of Direct Radiography Corp. Support.*

To view Detector log files, click the Log File(s) link on the Array Control Panel page, or the Logs link on any of the other Array pages. The Advanced Search and Detailed Log Info page displays. The operations you can perform from this page are described in Table 5-1.

NOTE: *For security purposes, you may be prompted to enter a login name and password before executing this function. For more information, refer to "Function Security Levels and Login Prompts" on page 5-2.*

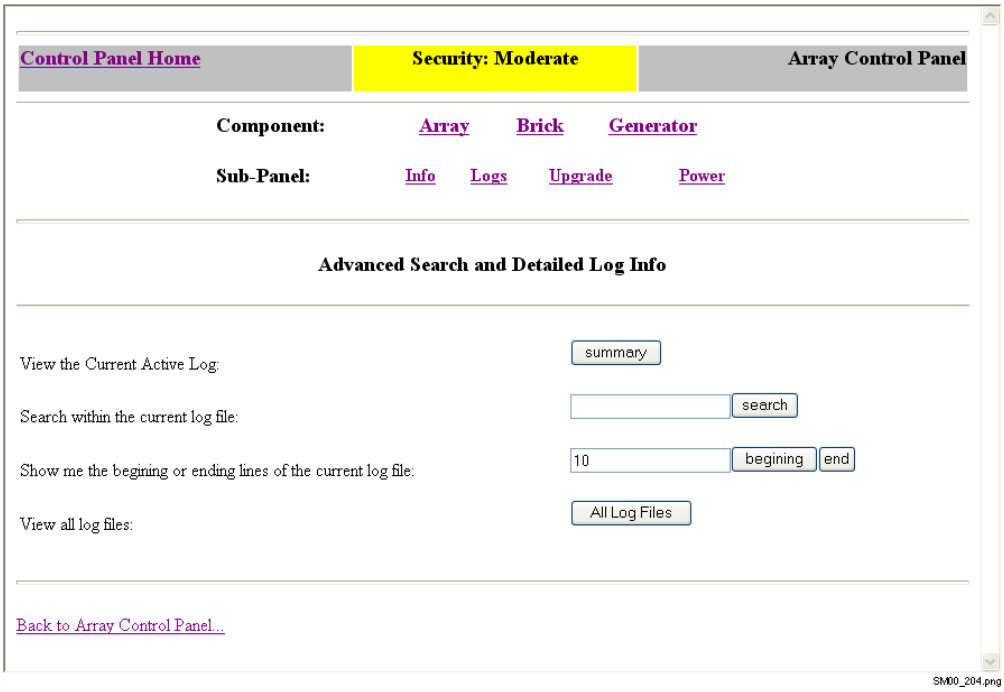
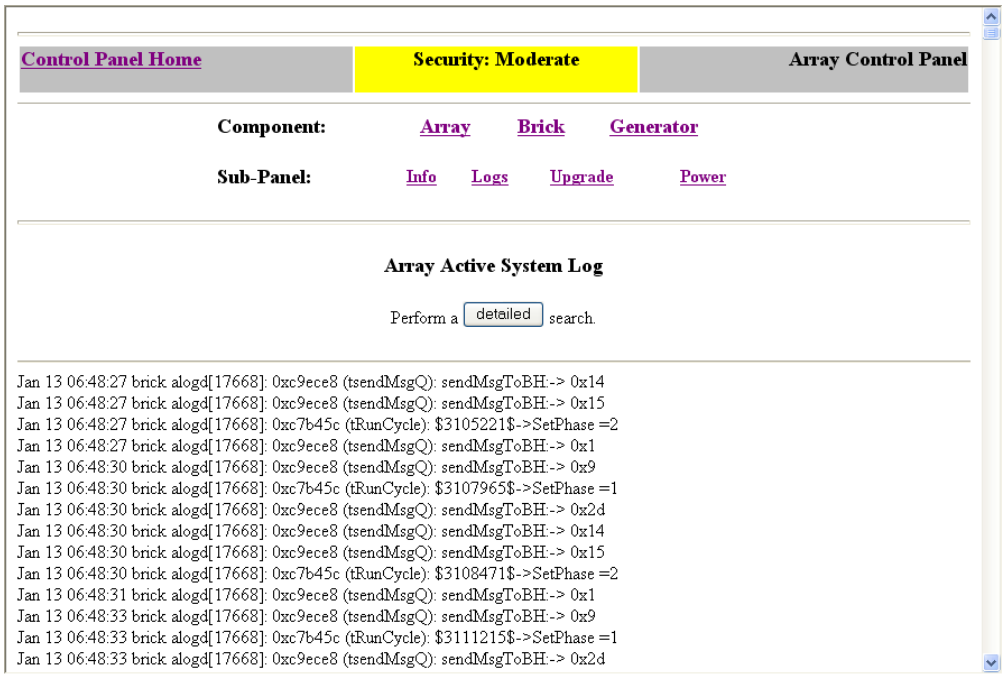


Table 5-1. Advanced Search and Detailed Log Page Operations

To:	Do This:
View the current active log.	Click the **Summary** button.
Search for a text string in the current active log, and display the line in the log file in which it appears.	Enter a search string in the adjacent field, then click the **Search** button.
Display the first or last lines in the current active log.	Enter the number of lines you want to display in the adjacent field, then click either the **Beginning** or **End** button.
View the current and all previous log files.	Click the **All Log Files** button.

The following screen shot shows an example of the current active log listing (displayed by clicking the **Summary** button).


Control Panel Home
Security: Moderate
Array Control Panel
Component: Array Brick Generator
Sub-Panel: Info Logs Upgrade Power
Array Active System Log
Perform a detailed search.
Jan 13 06:48:27 brick alogd[17668]: 0xc9ece8 (tsendMsgQ): sendMsgToBH:-> 0x14
Jan 13 06:48:27 brick alogd[17668]: 0xc9ece8 (tsendMsgQ): sendMsgToBH:-> 0x15
Jan 13 06:48:27 brick alogd[17668]: 0xc7b45c (tRunCycle): 3105221->SetPhase =2
Jan 13 06:48:27 brick alogd[17668]: 0xc9ece8 (tsendMsgQ): sendMsgToBH:-> 0x1
Jan 13 06:48:30 brick alogd[17668]: 0xc9ece8 (tsendMsgQ): sendMsgToBH:-> 0x9
Jan 13 06:48:30 brick alogd[17668]: 0xc7b45c (tRunCycle): 3107965->SetPhase =1
Jan 13 06:48:30 brick alogd[17668]: 0xc9ece8 (tsendMsgQ): sendMsgToBH:-> 0x2d
Jan 13 06:48:30 brick alogd[17668]: 0xc9ece8 (tsendMsgQ): sendMsgToBH:-> 0x14
Jan 13 06:48:30 brick alogd[17668]: 0xc9ece8 (tsendMsgQ): sendMsgToBH:-> 0x15
Jan 13 06:48:30 brick alogd[17668]: 0xc7b45c (tRunCycle): 3108471->SetPhase =2
Jan 13 06:48:31 brick alogd[17668]: 0xc9ece8 (tsendMsgQ): sendMsgToBH:-> 0x1
Jan 13 06:48:33 brick alogd[17668]: 0xc9ece8 (tsendMsgQ): sendMsgToBH:-> 0x9
Jan 13 06:48:33 brick alogd[17668]: 0xc7b45c (tRunCycle): 3111215->SetPhase =1
Jan 13 06:48:33 brick alogd[17668]: 0xc9ece8 (tsendMsgQ): sendMsgToBH:-> 0x2d
SM00_205.png

To return to the Advanced Search and Detailed Log Info page from the active log listing page, click the **Detailed** button.

Upgrading Detector Software Components

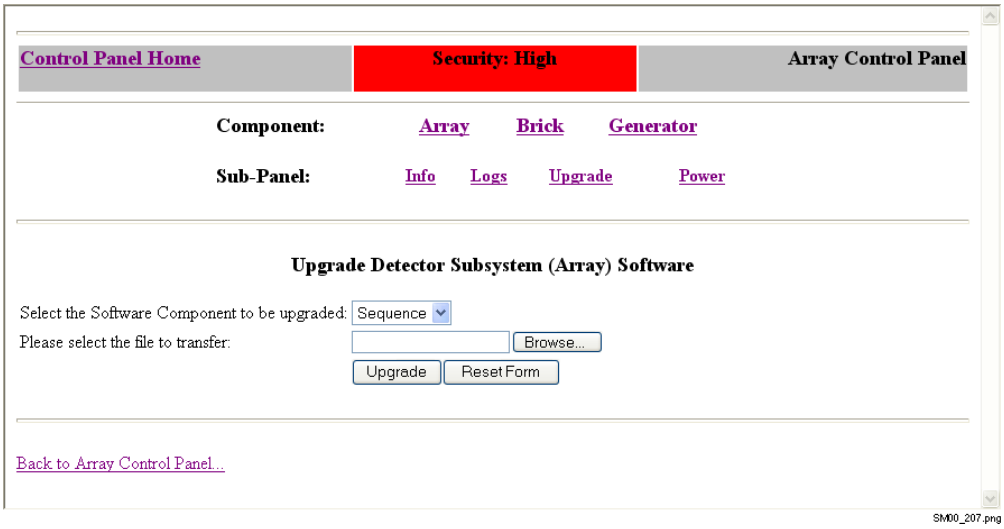
NOTE: *Typically, you will be upgrading an Detector software component only at the direction of Direct Radiography Corp., or if you suspect that the current software component is corrupt.*

To upgrade one of the Detector's software components:

1. Click the Software Upgrade link on the Array Control Panel page, or the Upgrade link on any of the other Array pages.

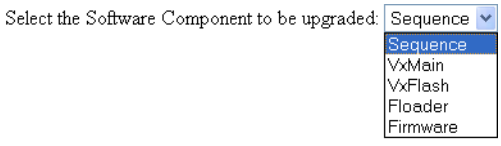
   The Upgrade Detector Subsystem (Array) Software page displays.

NOTE: *For security purposes, you may be prompted to enter a login name and password before executing this function. For more information, refer to "Function Security Levels and Login Prompts" on page 5-2.*



SM00_207.png

2. Select the software component that you want to upgrade.



SM00_208.png

3. Click the **Browse** button, then navigate to and select the appropriate software component file from your Acquisition Workstation's file system.

   The file you selected is displayed in the **Please select the file to transfer** field

CAUTION The PXCM Web Tool does not check that the appropriate file type has been selected. If you select the wrong file to upload, you could cause the PXCM to stop operating.

NOTE: *To clear your file selection, click the* ***Reset Form*** *button.*

4. When you are ready to start the software file transfer, click the **Upgrade** button.

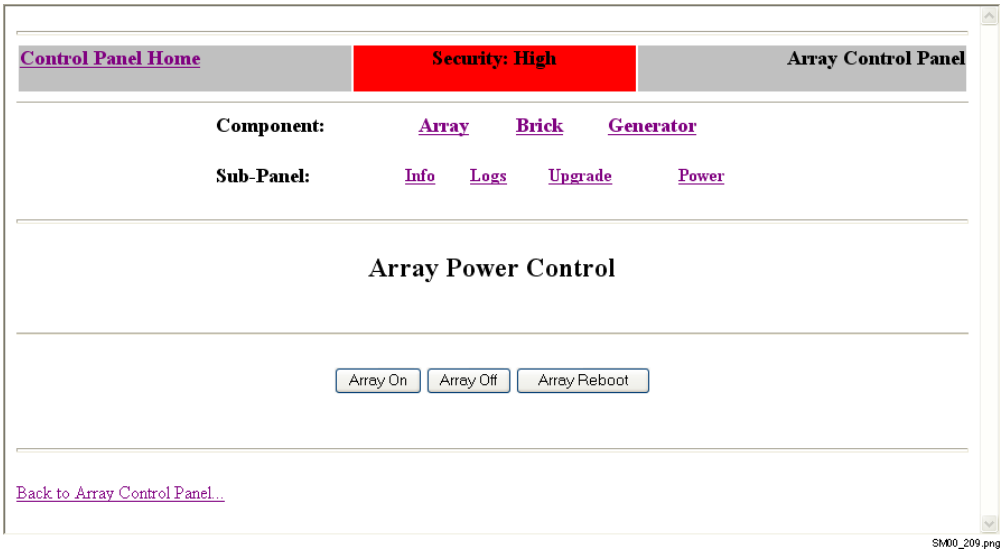
   The file transfer status is displayed on the page.

5. After the transfer is complete, reboot the Detector to have it start up using the software you just transferred. For information about rebooting the Detector, refer to "Powering the Detector On and Off" on page 5-9.

Powering the Detector On and Off

To power the Detector on or off, or reboot it, click the Array Power Control link on the Array Control Panel page, or the Power link on any of the other Array pages. The Array Power Control page displays. Click the appropriate button for the operation that you want to perform.

NOTE: *For security purposes, you may be prompted to enter a login name and password before executing this function. For more information, refer to "Function Security Levels and Login Prompts" on page 5-2.*



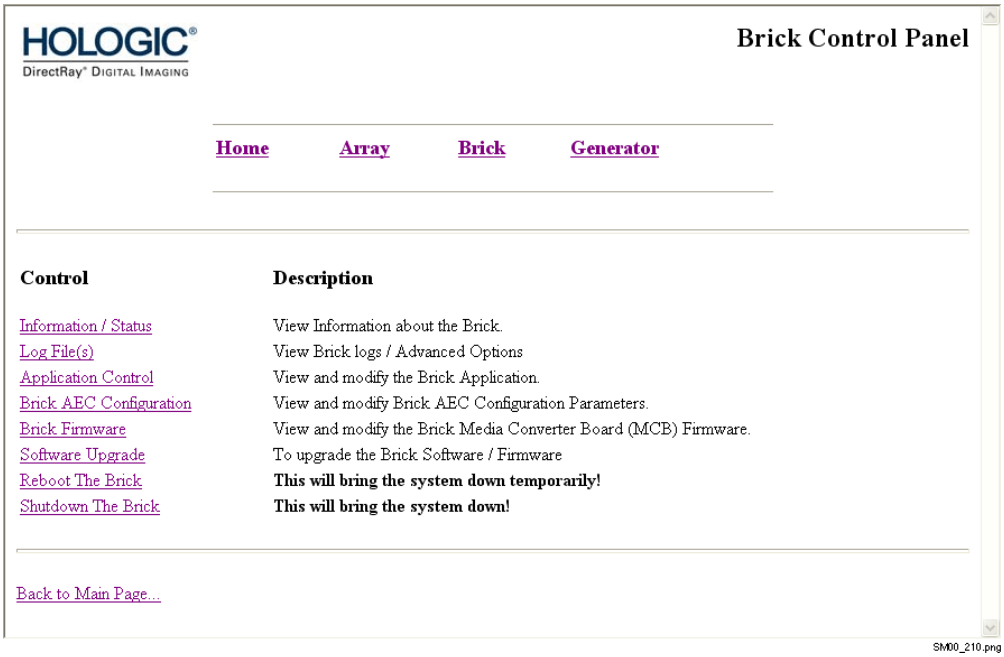
SM00_209.png

PXCM (Brick) Functions

The PXCM functions are accessible from the Brick Control Panel page.

NOTE: *The PXCM is also referred to as the "brick." Therefore, you will see the terms "PXCM" and "brick" used interchangeable throughout the web tool and the PXCM topics in this chapter.*

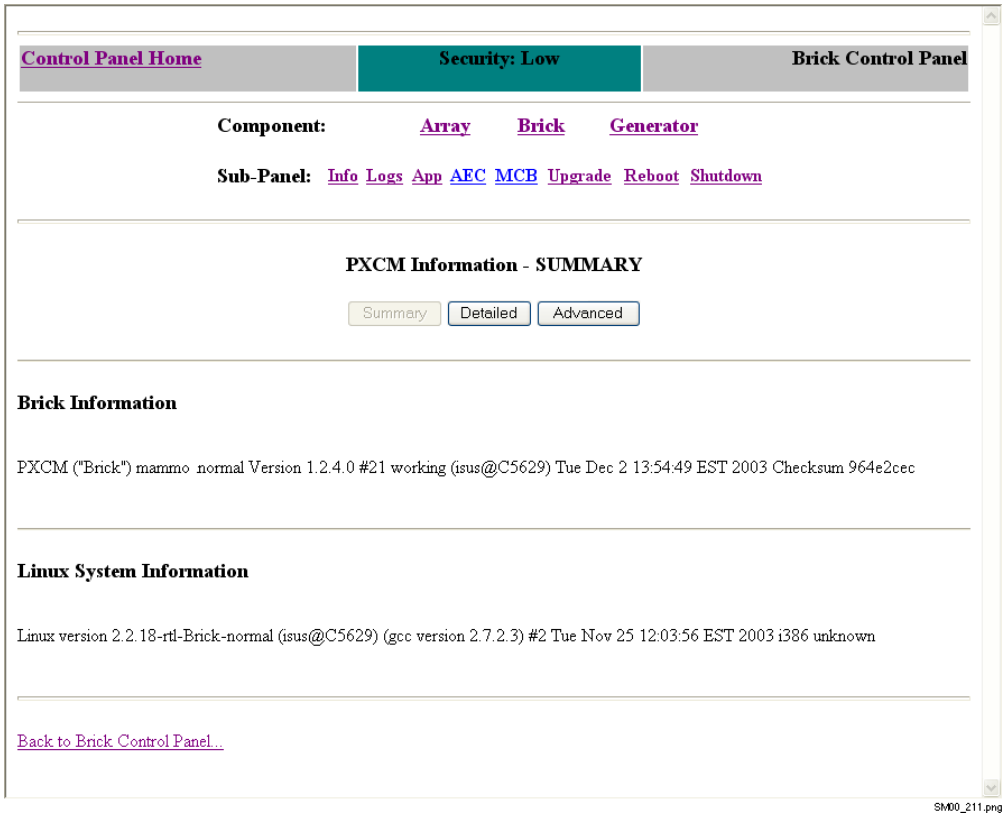
To display the Brick Control Panel page, click either of the Brick links on the home page.



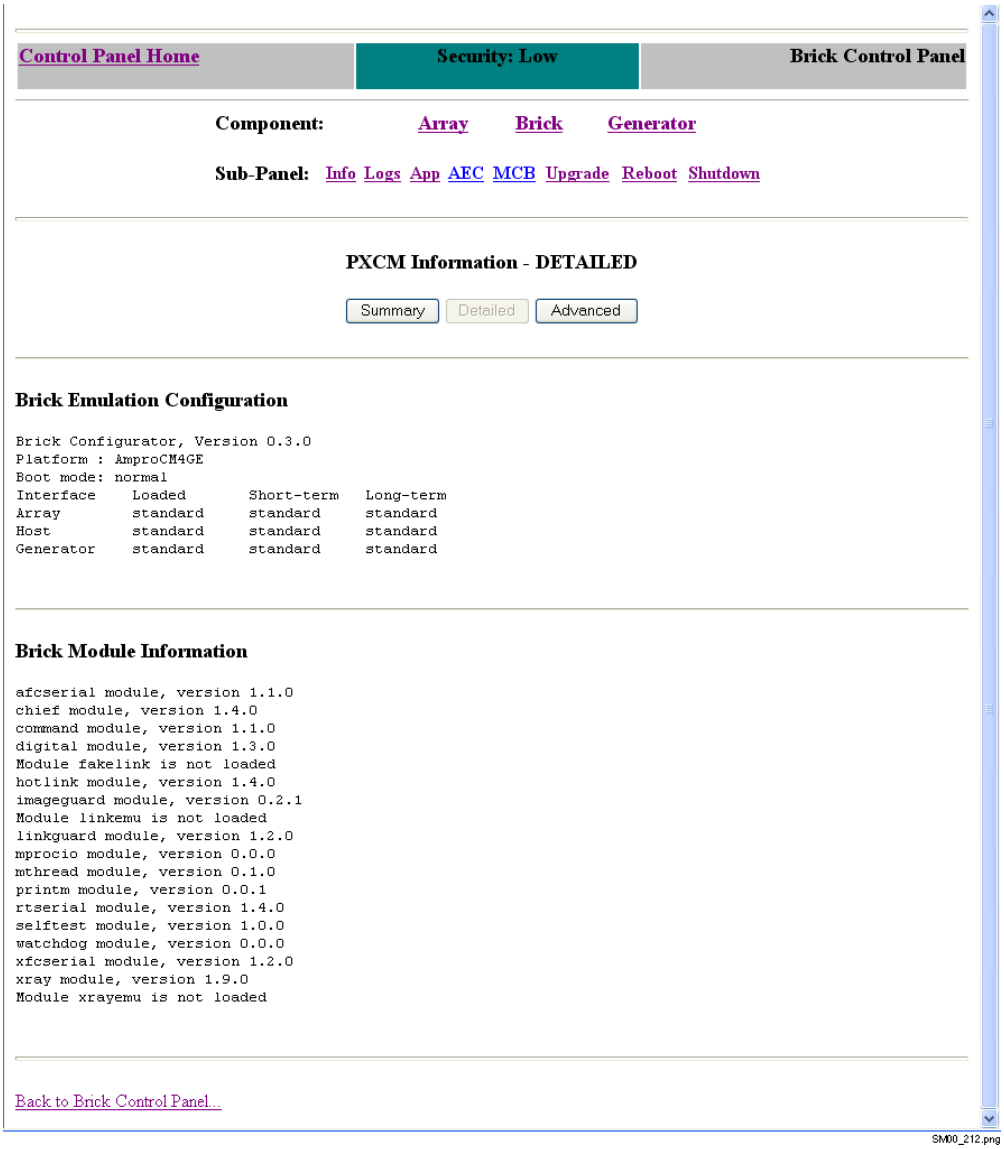
SM00_210.png

Viewing Information About the PXCM

To view information about the PXCM, click the Information/Status link on the Brick Control Panel page, or the Info link on any of the other PXCM pages. The PXCM Information - Summary page displays.


Control Panel Home
Security: Low
Brick Control Panel
Component: Array Brick Generator
Sub-Panel: Info Logs App AEC MCB Upgrade Reboot Shutdown
PXCM Information - SUMMARY
Summary
Detailed
Advanced
Brick Information
PXCM ("Brick") mammo normal Version 1.2.4.0 #21 working (isus@C5629) Tue Dec 2 13:54:49 EST 2003 Checksum 964e2cec
Linux System Information
Linux version 2.2.18-rtl-Brick-normal (isus@C5629) (gcc version 2.7.2.3) #2 Tue Nov 25 12:03:56 EST 2003 i386 unknown
Back to Brick Control Panel...
SM00_211.png

To view more detailed PXCM information, click the **Detailed** button. A sample of the PXCM detailed information is shown on the following page.



SM00_212.png

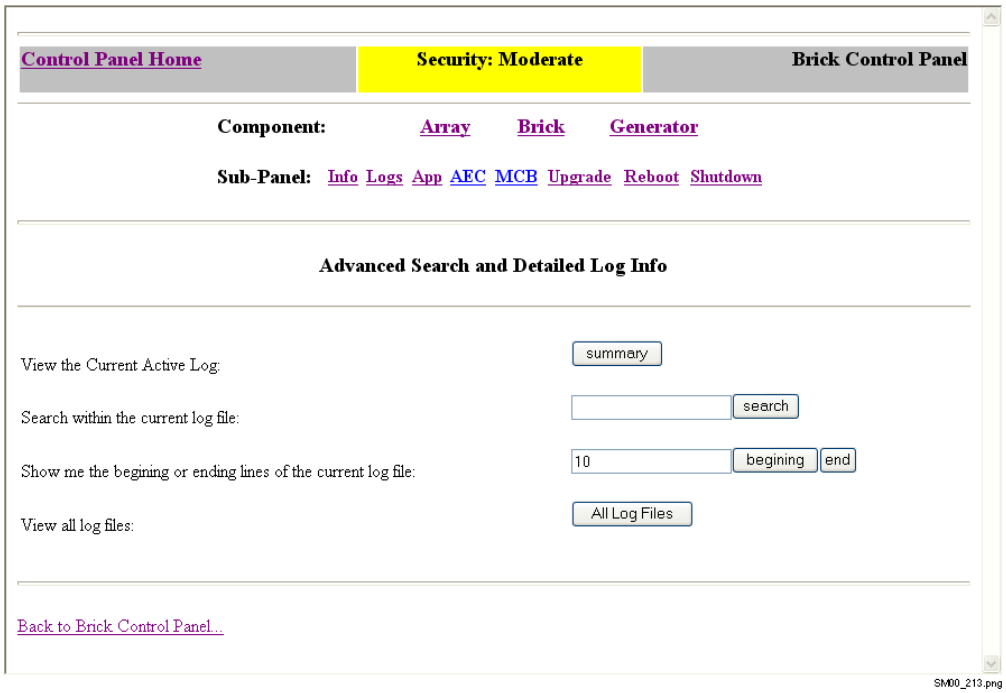
NOTE: *The PXCM Information page also includes an* ***Advanced*** *button for displaying even more detailed information. However, this advanced information is intended only as an aid to Direct Radiography Corp. Support staff in troubleshooting PXCM problems. For this reason, you will typically be using this function only at the direction of Direct Radiography Corp. Support.*

Viewing PXCM Log Files

NOTE: *PXCM log file information is intended as an aid to Direct Radiography Corp. Support staff in troubleshooting PXCM problems. For this reason, you will typically be using this function only at the direction of Direct Radiography Corp. Support.*

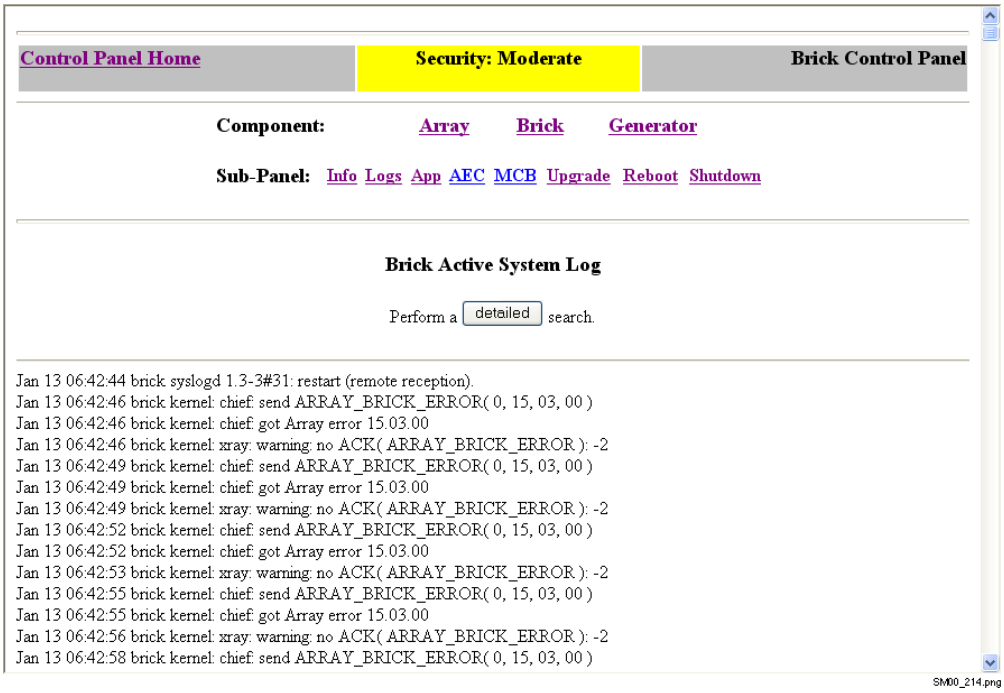
To view PXCM log files, click the Log File(s) link on the Brick Control Panel page, or the Logs link on any of the other PXCM pages. The Advanced Search and Detailed Log Info page displays. The operations you can perform from this page are described in Table 5-1 on page 5-6.

NOTE: *For security purposes, you may be prompted to enter a login name and password before executing this function. For more information, refer to "Function Security Levels and Login Prompts" on page 5-2.*



SM00_213.png

The following screen shot shows an example of the current active log listing (displayed by clicking the **Summary** button).


Control Panel Home
Security: Moderate
Brick Control Panel
Component: Array Brick Generator
Sub-Panel: Info Logs App AEC MCB Upgrade Reboot Shutdown
Brick Active System Log
Perform a detailed search.
Jan 13 06:42:44 brick syslogd 1.3-3#31: restart (remote reception).
Jan 13 06:42:46 brick kernel: chief: send ARRAY_BRICK_ERROR(0, 15, 03, 00)
Jan 13 06:42:46 brick kernel: chief: got Array error 15.03.00
Jan 13 06:42:46 brick kernel: xray: warning: no ACK(ARRAY_BRICK_ERROR): -2
Jan 13 06:42:49 brick kernel: chief: send ARRAY_BRICK_ERROR(0, 15, 03, 00)
Jan 13 06:42:49 brick kernel: chief: got Array error 15.03.00
Jan 13 06:42:49 brick kernel: xray: warning: no ACK(ARRAY_BRICK_ERROR): -2
Jan 13 06:42:52 brick kernel: chief: send ARRAY_BRICK_ERROR(0, 15, 03, 00)
Jan 13 06:42:52 brick kernel: chief: got Array error 15.03.00
Jan 13 06:42:53 brick kernel: xray: warning: no ACK(ARRAY_BRICK_ERROR): -2
Jan 13 06:42:55 brick kernel: chief: send ARRAY_BRICK_ERROR(0, 15, 03, 00)
Jan 13 06:42:55 brick kernel: chief: got Array error 15.03.00
Jan 13 06:42:56 brick kernel: xray: warning: no ACK(ARRAY_BRICK_ERROR): -2
Jan 13 06:42:58 brick kernel: chief: send ARRAY_BRICK_ERROR(0, 15, 03, 00)
SM00_214.png

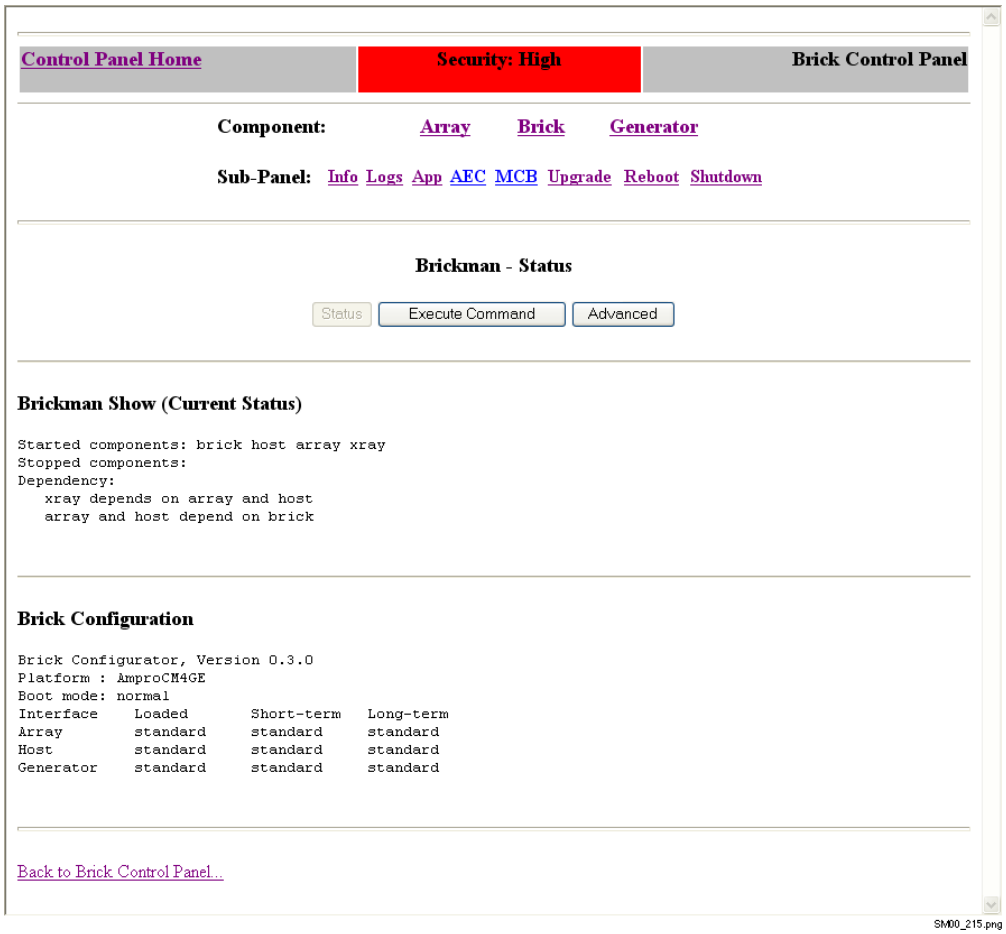
To return to the Advanced Search and Detailed Log Info page from the active log listing page, click the **Detailed** button.

Viewing PXCM Application Information

NOTE: *PXCM application information is intended as an aid to Direct Radiography Corp. Support staff in troubleshooting PXCM problems. For this reason, you will typically be using this function only at the direction of Direct Radiography Corp. Support.*

To view PXCM application information, click the Application Control link on the Brick Control Panel page, or the App link on any of the other PXCM pages. The Brickman - Status page displays.

NOTE: *For security purposes, you may be prompted to enter a login name and password before executing this function. For more information, refer to "Function Security Levels and Login Prompts" on page 5-2.*



SM00_215.png

CAUTION The Brickman page also includes an **Execute Command** button and an **Advanced** button. These functions are intended only as an aid to Direct Radiography Corp. Support staff in troubleshooting PXCM problems. Use of these functions could adversely affect PXCM operation.

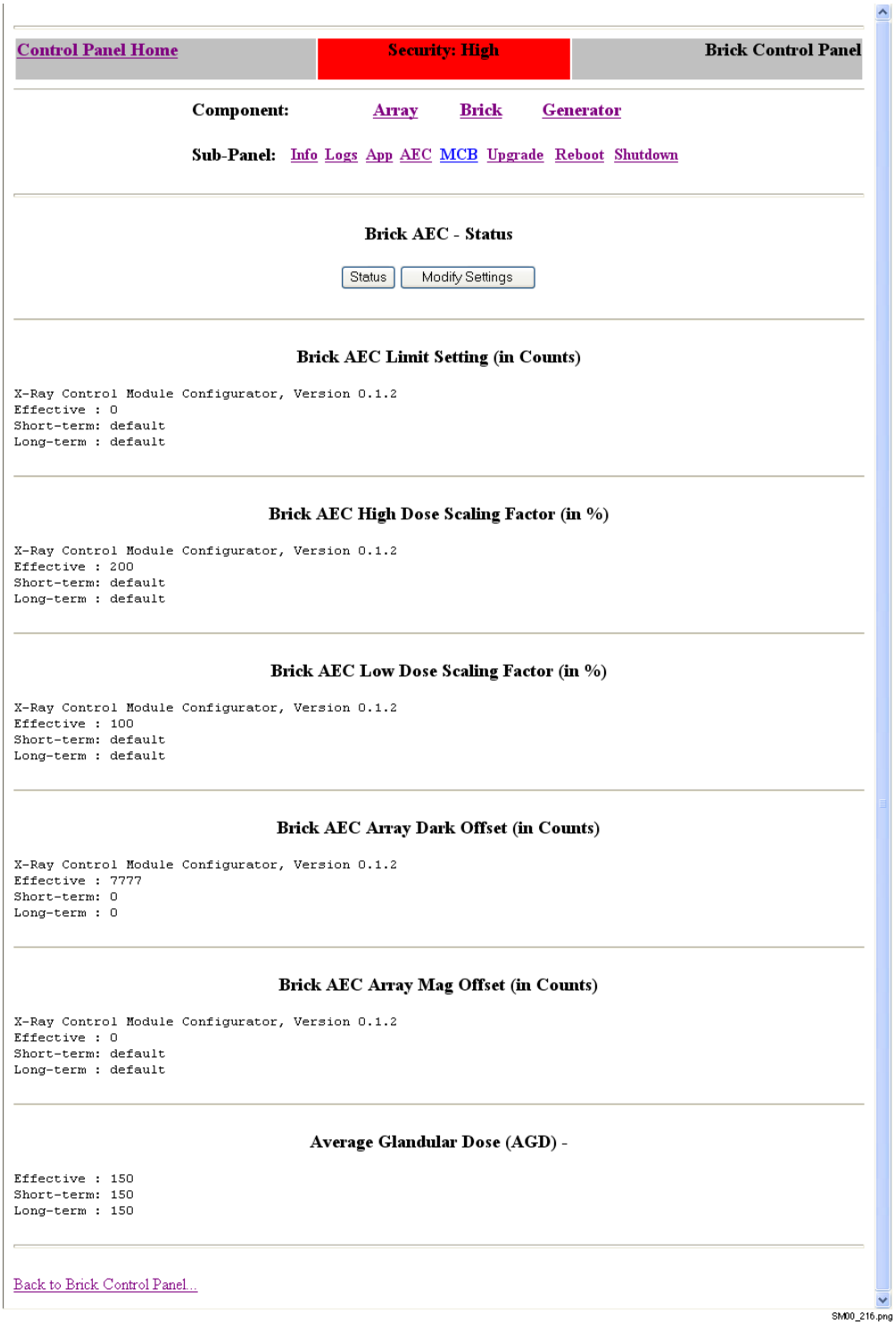
Viewing PXCM AEC Configuration Information

NOTE: *PXCM Automatic Exposure Control (AEC) configuration information is intended as an aid to Direct Radiography Corp. Support staff in troubleshooting AEC problems. For this reason, you will typically be using this function only at the direction of Direct Radiography Corp. Support.*

To view PXCM AEC configuration information, click the Brick AEC Configuration link on the Brick Control Panel page, or the AEC link on any of the other PXCM pages. The Brick AEC - Status page displays, as shown on the next page.

CAUTION The Brick AEC page also includes a **Modify Settings** button. This function is intended only as an aid to Direct Radiography Corp. Support staff in troubleshooting AEC problems. Use of this function could adversely affect AEC operation.

NOTE: *For security purposes, you may be prompted to enter a login name and password before executing this function. For more information, refer to "Function Security Levels and Login Prompts" on page 5-2.*

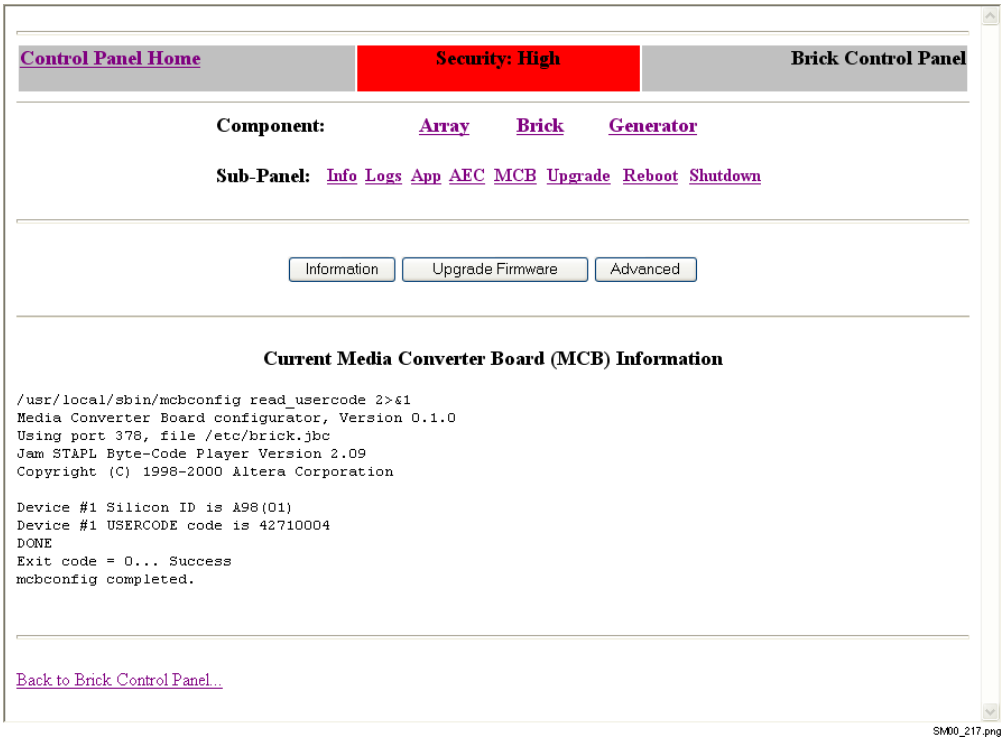

Control Panel Home
Security: High
Brick Control Panel
Component: Array Brick Generator
Sub-Panel: Info Logs App AEC MCB Upgrade Reboot Shutdown
Brick AEC - Status
Status
Modify Settings
Brick AEC Limit Setting (in Counts)
X-Ray Control Module Configurator, Version 0.1.2
Effective : 0
Short-term: default
Long-term : default
Brick AEC High Dose Scaling Factor (in %)
X-Ray Control Module Configurator, Version 0.1.2
Effective : 200
Short-term: default
Long-term : default
Brick AEC Low Dose Scaling Factor (in %)
X-Ray Control Module Configurator, Version 0.1.2
Effective : 100
Short-term: default
Long-term : default
Brick AEC Array Dark Offset (in Counts)
X-Ray Control Module Configurator, Version 0.1.2
Effective : 7777
Short-term: 0
Long-term : 0
Brick AEC Array Mag Offset (in Counts)
X-Ray Control Module Configurator, Version 0.1.2
Effective : 0
Short-term: default
Long-term : default
Average Glandular Dose (AGD) -
Effective : 150
Short-term: 150
Long-term : 150
Back to Brick Control Panel...
SM00_216.png

Viewing Media Converter Board (MCB) Information and Upgrading Its Firmware

NOTE: *Viewing MCB information, or upgrading its firmware, is intended as an aid to Direct Radiography Corp. Support staff in troubleshooting PXCM problems. For this reason, you will typically be using these functions only at the direction of Direct Radiography Corp. Support.*

To view MCB firmware information, click the Brick Firmware link on the Brick Control Panel page, or the MCB link on any of the other PXCM pages. The MCB page displays.

NOTE: *For security purposes, you may be prompted to enter a login name and password before executing this function. For more information, refer to "Function Security Levels and Login Prompts" on page 5-2.*


Control Panel Home
Security: High
Brick Control Panel
Component: Array Brick Generator
Sub-Panel: Info Logs App AEC MCB Upgrade Reboot Shutdown
Information
Upgrade Firmware
Advanced
Current Media Converter Board (MCB) Information
/usr/local/sbin/mcbconfig read_usercode 2>&1
Media Converter Board configurator, Version 0.1.0
Using port 378, file /etc/brick.jbc
Jam STAPL Byte-Code Player Version 2.09
Copyright (C) 1998-2000 Altera Corporation
Device #1 Silicon ID is A98(01)
Device #1 USERCODE code is 42710004
DONE
Exit code = 0... Success
mcbconfig completed.
Back to Brick Control Panel...
SM00_217.png

CAUTION The MCB page includes an **Advanced** button. This function is intended only as an aid to Direct Radiography Corp. Support staff in troubleshooting AEC problems. Use of this function could adversely affect MCB operation.

To upgrade the MCB firmware:

1. Click the **Upgrade Firmware** button on the MCB page.

   The Upgrade PXCM Firmware (MCB) page displays.

2. Click the **Browse** button, then navigate to and select the appropriate MCB firmware file from your Acquisition Workstation's file system.

   The file you selected is displayed in the **Please select the Firmware file to transfer** field

CAUTION The PXCM Web Tool does not check that the appropriate file type has been selected. If you select the wrong file to upload, you could cause the PXCM to stop operating.

NOTE: *To clear your file selection, click the* ***Reset Form*** *button.*

3. When you are ready to start the firmware file transfer, click the **Upgrade Now** button.

   The file transfer status is displayed on the page.

4. After the transfer is complete, reboot the PXCM to have it start up using the firmware you just transferred. For information, refer to "Rebooting the PXCM" on page 5-21.

Upgrading the PXCM Software

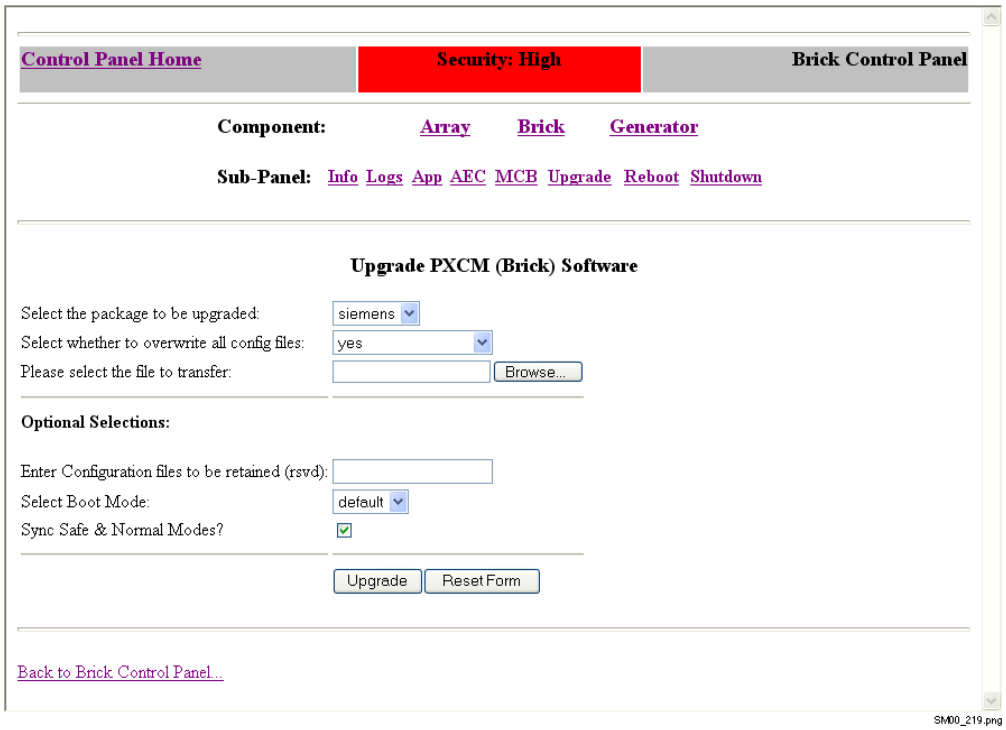
NOTE: *Typically, you will be upgrading an PXCM software only at the direction of Direct Radiography Corp., or if you suspect that the current software is corrupt.*

To upgrade the PXCM's software:

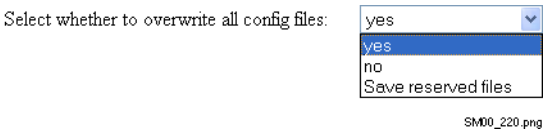
1. Click the Software Upgrade link on the PXCM Control Panel page, or the Upgrade link on any of the other PXCM pages.

   The Upgrade PXCM Software page displays.

NOTE: *For security purposes, you may be prompted to enter a login name and password before executing this function. For more information, refer to "Function Security Levels and Login Prompts" on page 5-2.*


Control Panel Home
Security: High
Brick Control Panel
Component: Array Brick Generator
Sub-Panel: Info Logs App AEC MCB Upgrade Reboot Shutdown
Upgrade PXCM (Brick) Software
Select the package to be upgraded: siemens
Select whether to overwrite all config files: yes
Please select the file to transfer: Browse...
Optional Selections:
Enter Configuration files to be retained (rsvd):
Select Boot Mode: default
Sync Safe & Normal Modes?
Upgrade Reset Form
Back to Brick Control Panel...
SM00_219.png

2. For the **Select the package to be upgraded** option, select **siemens**.
3. Select whether you want to overwrite all of the PXCM configuration files.



SM00_220.png

   If you select the **Save reserved files** option, specify the files you want to protect from being overwritten in the **Enter Configuration files to be retained** field.

4. Click the **Browse** button, then navigate to and select the appropriate PXCM software file from your Acquisition Workstation's file system.

   The file you selected is displayed in the **Please select the file to transfer** field.

CAUTION The PXCM Web Tool does not check that the appropriate file type has been selected. If you select the wrong file to upload, you could cause the PXCM to stop operating.

5. For the **Select Boot Mode** option, select **normal**, unless directed to select a different mode by Direct Radiography Corp. Support.
6. Select the **Sync Safe & Normal Modes?** option.

NOTE: *To clear your entries or selections, click the* ***Reset Form*** *button.*

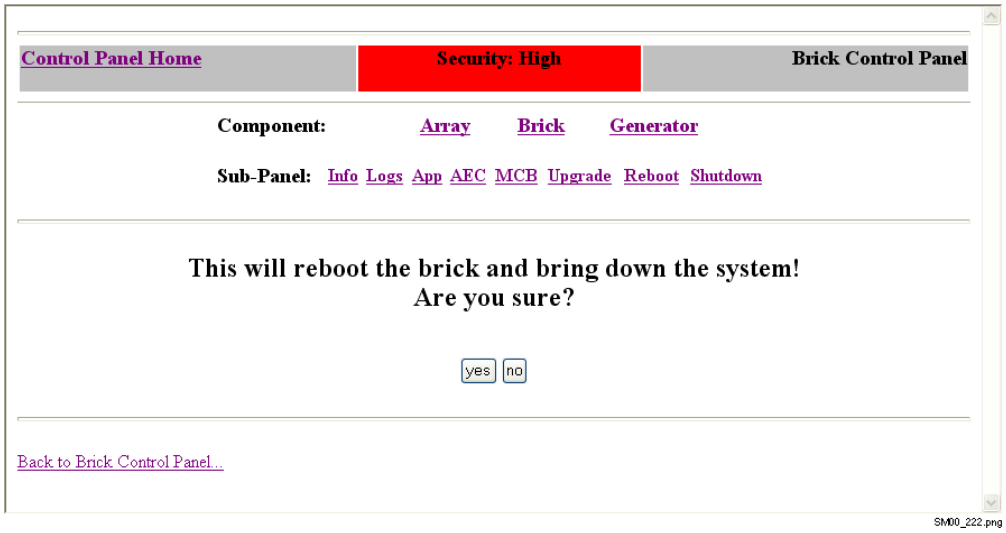
7. When you are ready to start the software file transfer, click the **Upgrade** button.

   The file transfer status is displayed on the page.
8. After the transfer is complete, reboot the PXCM to have it start up using the software you just transferred. For information about rebooting the PXCM, refer to "Powering the Detector On and Off" on page 5-9.

Rebooting the PXCM

To reboot the PXCM, click the Reboot the Brick link on the Array Control Panel page, or the Reboot link on any of the other PXCM pages. You will be prompted to confirm the reboot operation.

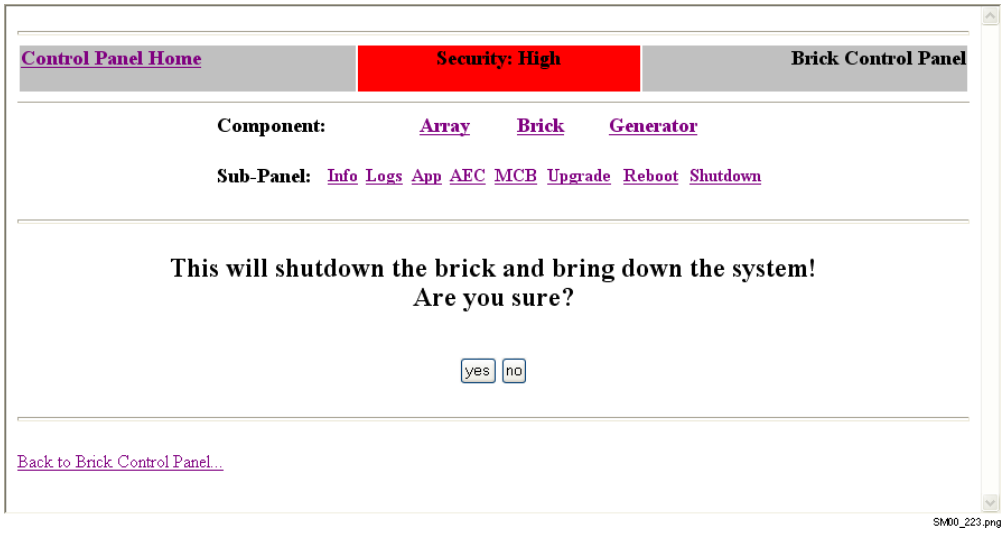
NOTE: *For security purposes, you may be prompted to enter a login name and password before executing this function. For more information, refer to "Function Security Levels and Login Prompts" on page 5-2.*


Control Panel Home
Security: High
Brick Control Panel
Component: Array Brick Generator
Sub-Panel: Info Logs App AEC MCB Upgrade Reboot Shutdown
This will reboot the brick and bring down the system!
Are you sure?
yes
no
Back to Brick Control Panel...
SM00_222.png

Shutting Down the PXCM

To shut down the PXCM, click the Shutdown the Brick link on the Array Control Panel page, or the Shutdown link on any of the other PXCM pages. You will be prompted to confirm the shutdown operation.

NOTE: *For security purposes, you may be prompted to enter a login name and password before executing this function. For more information, refer to "Function Security Levels and Login Prompts" on page 5-2.*


Control Panel Home
Security: High
Brick Control Panel
Component: Array Brick Generator
Sub-Panel: Info Logs App AEC MCB Upgrade Reboot Shutdown
This will shutdown the brick and bring down the system!
Are you sure?
yes
no
Back to Brick Control Panel...
SM00_223.png

Generator Functions

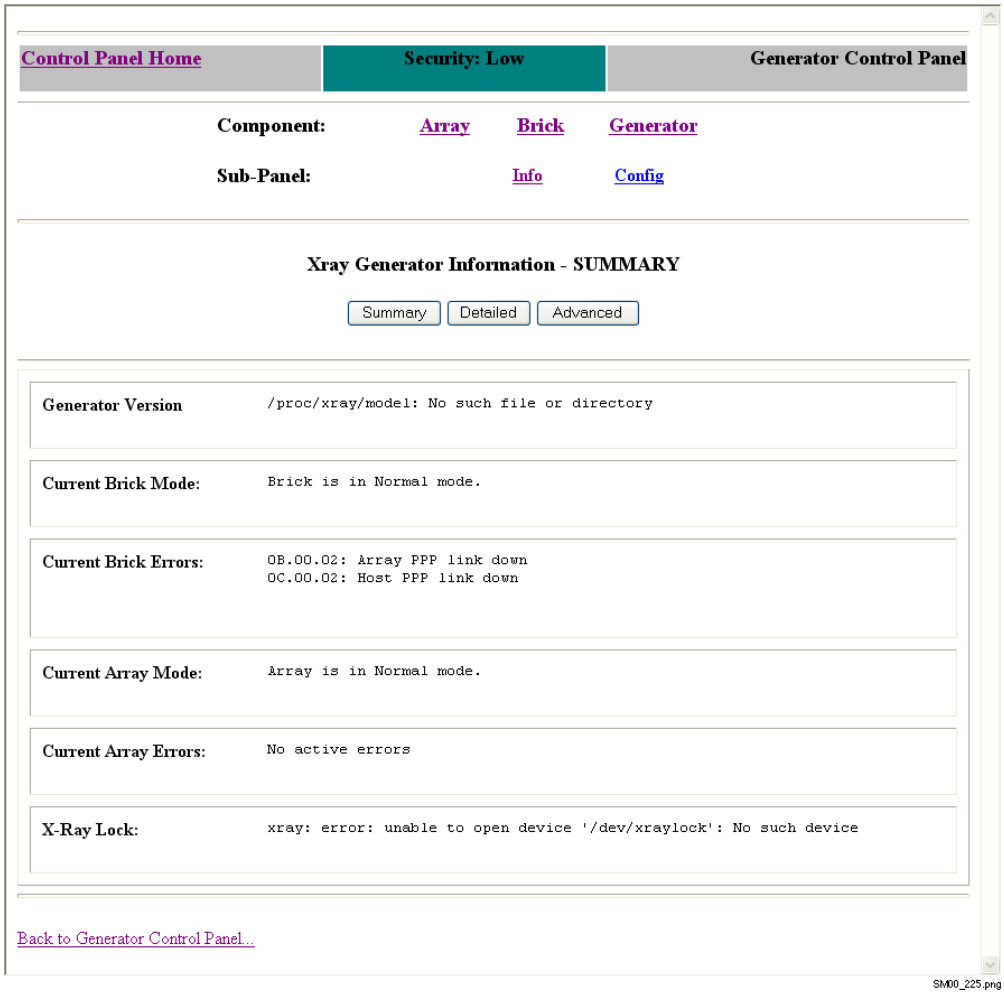
The Generator functions are accessible from the Generator Control Panel page.

To display the Generator Control Panel page, click either of the Generator links on the home page.

SM00_224.png

Viewing Information About the Generator

To view information about the Generator, click the Information/Status link on the Generator Control Panel page, or the Info link on any of the other Generator pages. The Generator Information - Summary page displays.



SM00_225.png

To view more detailed Generator information, click the **Detailed** button. A sample of the Generator detailed information is shown on the next page.

NOTE: *The Generator Information page also includes an* ***Advanced*** *button for displaying even more detailed information. However, this advanced information is intended only as an aid to Direct Radiography Corp. Support staff in troubleshooting Generator problems. For this reason, you will typically be using this function only at the direction of Direct Radiography Corp. Support.*

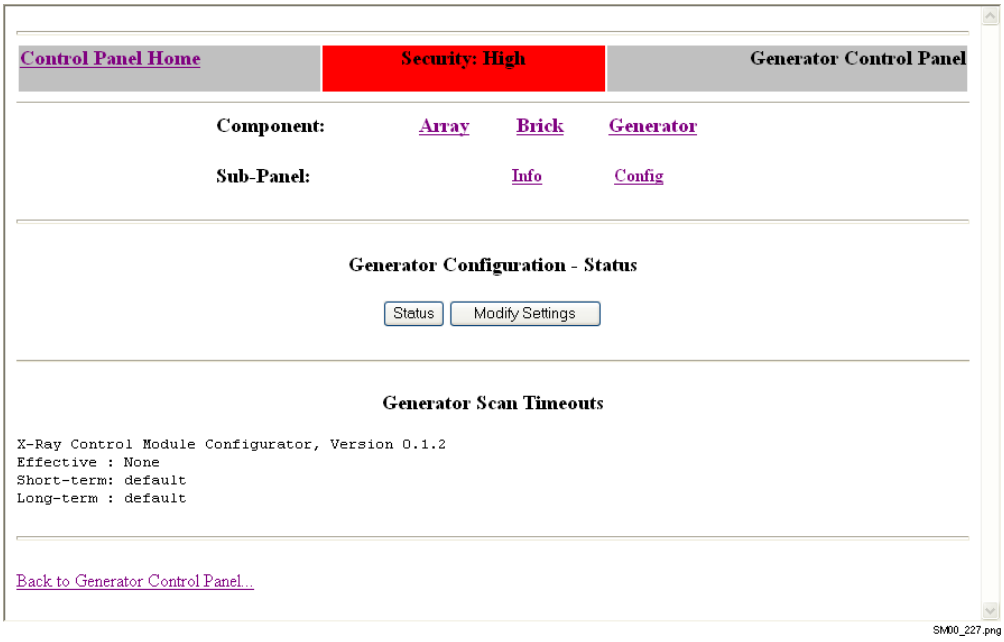
Control Panel Home
Security: Low
Generator Control Panel
Component:
Array
Brick
Generator
Sub-Panel:
Info
Config
Xray Generator Information - DETAILED
Summary
Detailed
Advanced
Generator Version
/proc/xray/model: No such file or directory
Current Brick Mode:
Brick is in Normal mode.
Current Brick Errors:
0B.00.02: Array PPP link down
0C.00.02: Host PPP link down
Current Array Mode:
Array is in Normal mode.
Current Array Errors:
No active errors
X-Ray Lock:
xray: error: unable to open device '/dev/xraylock': No such device
X-Ray Scan Information:
X-Ray Control Module is not loaded.
X-Ray Brick Information:
X-Ray Control Module is not loaded.
X-Ray Array Information
X-Ray Control Module is not loaded.
X-Ray Link Information:
X-Ray Control Module is not loaded.
X-Ray Host Information:
X-Ray Control Module is not loaded.
X-Ray Scan Errors:
X-Ray Control Module is not loaded
X-Ray Brick Errors:
X-Ray Control Module is not loaded
X-Ray Serial Errors:
X-Ray Control Module is not loaded
Back to Generator Control Panel...
SM00_226.png

Viewing and Modifying the Generator Configuration

NOTE: *Viewing or modifying the Generator configuration is intended as an aid to Direct Radiography Corp. Support staff in troubleshooting system problems. For this reason, you will typically be using these functions only at the direction of Direct Radiography Corp. Support.*

To view Generator configuration information, click the Configure Generator link on the Generator Control Panel page, or the Config link on any of the other Generator pages. The Generator Configuration - Status page displays.

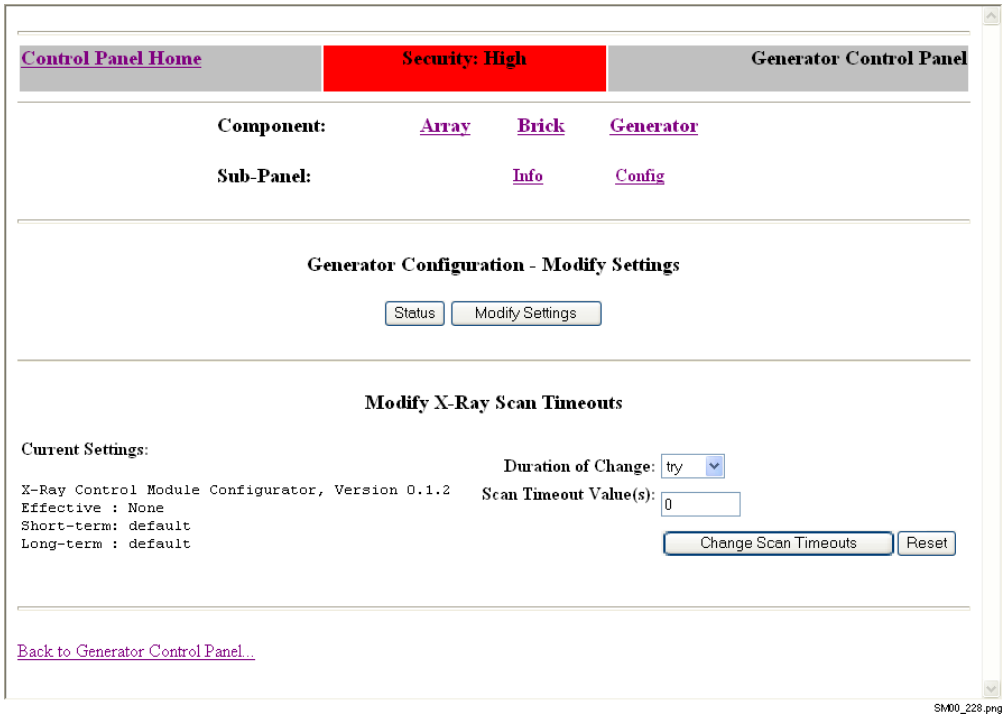
NOTE: *For security purposes, you may be prompted to enter a login name and password before executing this function. For more information, refer to "Function Security Levels and Login Prompts" on page 5-2.*



To change the Generator configuration settings:

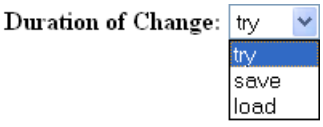
1. Click the **Modify Settings** button on the Generator Configuration page.

   The Generator Configuration - Modify Settings page displays.



SM00_228.png

2. Select the **Duration of Change** option to specify how long you want the new scan timeout value to be in effect.



SM00_229.png

NOTE: *To clear your selection and entry, click the* ***Reset*** *button.*

3. In the **Scan Timeout Value** field, enter the timeout value (in seconds).
4. To save your modifications, click the **Change Scan Timeouts** button.

Factory Service Functions

The Factory Service functions allow you to view a summary of information about the Detector, the PXCM, and the Generator. It also allows you to save critical logs to files that can be sent to Direct Radiography Corp. for troubleshooting analysis.

NOTE: *The log files are intended as an aid to Direct Radiography Corp. Support staff in troubleshooting system problems. For this reason, you will typically be using the Factory Service functions only at the direction of Direct Radiography Corp. Support.*

The Factory Service functions are accessible from the Factory Service Control Panel page.

To display the Factory Service Control Panel page, click the Factory Service link on the home page.

The summary information is displayed on the page. The page also includes a listing of the available logs.

To save the PXCM run-time statistics to an archive (tar) and compressed file, click the Brick Run-Time Stats link. From the dialog box that displays, you can name and save the file in the Acquisition Workstation's file system.

To save a log to a file, right-click on the link, then choose **Save Target As** from the pop-up menu. From the dialog box that displays, you can name and save the log file in the Acquisition Workstation's file system.

To view a log, click its link. The log contents display on a new page.

6

Maintaining Image Quality

This chapter contains information to help maintain acceptable image quality.

DirectRay Detector Calibration

While calibration is typically performed by the customer as part of normal system operation, calibration information is provided in the event that you are required to perform a system calibration.

What Calibration Does

The DirectRay Detector captures charge in its TFT, which is then carried as an electronic signal through charge amplifiers and analog-to-digital conversion to generate a digital signal. While the charge amplifiers are matched, small differences in their performance can result in differences in the X-ray densities detected for the same amount of X-ray.

Performing calibration allows the system to detect these small differences, along with other variables that can affect the digital signal output. The system can then apply adjustments to the output data to compensate for these differences.

When to Calibrate the DirectRay Detector

Calibration of the DirectRay Detector must be done:

- Once a week.
- When the Detector has been powered off.

NOTE: *Calibration must not be performed for at least one hour* ***after*** *the Detector has been powered on to allow it to warm up.*

- When the room temperature has varied more than ±3°C (±5.4°F) from the last calibration.

NOTE: *Calibration must always be performed according to Siemens Calibration Instructions.*

Troubleshooting Image Quality

DirectRay components, when operating incorrectly, can yield a variety of unacceptable imaging artifacts. These artifacts can come from anywhere along the chain of image capture, conversion, and display. The tables in this topic suggest the causes and corrective responses for particular problems.

A key step in analysis is to isolate the artifact to the component that is producing it. First, similar appearing artifacts can come from anywhere in the overall image chain. Second, the tendency to assume that the artifact is coming from the least known component must be avoided. For example, artifacts that appear to be coming from the DirectRay Detector may actually be coming from the output device or processing.

Isolation is the first step and should be done by using internally-generated image patterns in the image chain to determine where exactly the artifact is being produced ("what is/what is not" the artifact analysis).

The following tables provide direction for cause and corrective action for those artifacts that have been validated as coming from DirectRay components.

For troubleshooting questions, contact Direct Radiography Corp. Support.

Table 6-1. Line Artifacts

Problem	Cause	Recommended Action
Line Parallel to the Short Axis	Seam:	
	• Seam correction algorithm not turned on; wrong algorithm selected. • Detector gain not calibrated properly. • Seam (lines 1535 and 1536) needs to be mapped out.	Perform DirectRay Detector calibration procedure (refer to "When to Calibrate the DirectRay Detector" on page 6-1).
	Source lines:	
	• DirectRay Detector not calibrated properly.	• Perform DirectRay Detector calibration procedure.
	• Line needs to be mapped out.	• Contact Direct Radiography Corp. Support for information on bad pixel correction.
Line Parallel to the Long Axis	Line ends at seam or line partially defective (gate lines).	
	• Detector not calibrated properly.	• Perform DirectRay Detector calibration procedure.
	• Line needs to be mapped out.	• Contact Direct Radiography Corp. Support for information on bad pixel correction.
Line Runs Through Seam	• Read out problem; HV setting time too short.	• Follow applicable problem solving.
	• Hard copy device or processor artifact.	

Table 6-2. Random Artifacts

Problem	Cause	Recommended Action
Increase in Defective Pixels and Lines	Defective pixel file requires updating.	Contact Direct Radiography Corp. Support for information on bad pixel correction.

Table 6-3. Structured Artifacts

Problem	Cause	Recommended Action
Appearance of 24 “256 blocks” of different Densities or Counts	Gain calibration not turned on. Detector not calibrated properly.	Follow calibration procedure.
Image not appearing in One or More “256 blocks”	Detector defective.	Replace Detector.
Image not appearing in one or more quarters of Detector	Detector defective.	Replace Detector.
Garbled, scrambled, or truncated (from edges of long axis in) images	Poor cable connection. Electronic interference with or along cable.	Check pins and Detector connection to PXCM. Identify and isolate sources of interference; examine the cable pathway.
Fine Linear Pattern, Parallel to Long Axis, in One or More “256 Blocks” (usually more pronounced on an edge)	Electromagnetic noise interfering with Detector Read Out.	Shield Motors, power sources, and so on, located in proximity to the DirectRay Detector.

Table 6-4. Other Artifacts

Problem	Cause	Recommended Action
Density	Image is too dark or light.	Verify LUT curves are properly set.
No Image or Very High Exposure Required to Obtain an Image	HV setting incorrect. HV contact failed.	Check pac.cfg for correct setting. Replace DirectRay Detector.
High Contrast Objects Appear as Ghost Image	DirectRay Detector erase not working correctly.	Check pac.cfg for correct settings. Check for DirectRay Detector component failure.
White lines towards the center of panel (Bar Code)	DirectRay Detector defective.	Replace DirectRay Detector.
Dark lines / weak lines	Lines need to be mapped out.	Perform a procedure with X-ray and submit the file to Direct Radiography Corp. Support for mapping.
Poor image quality	DirectRay Detector not calibrated to optimal operating temperature.	Allow proper warm-up time to normal operational temperature.
Distorted image with 256 blocks	DirectRay Detector defective.	Replace DirectRay Detector.

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7

Troubleshooting Guidelines

This chapter explains the diagnostic and troubleshooting guidlines for the DirectRay FFDM-S components.

General Troubleshooting Guidelines

THIS TOPIC STILL UNDER DEVELOPMENT

Interpreting Results from PXCM Self-Test

THIS TOPIC STILL UNDER DEVELOPMENT

Interpreting the PXCM Status LEDs

The PXCM includes three status LEDs (shown in Figure 7-1 below):

- **V1—Fiber-optic communications status.** A red LED that lights to indicate lack of communication from the FFDM-S. Likely causes are misconnected fiber optic lines or the Detector being turned off.
- **V2—PXCM status.** A green LED that flashes to indicate normal operation of the PXCM. If this LED does not light for a significant amount of time (that is, 2 to 3 minutes), reboot the PXCM.
- **V3—Power status.** A green LED that lights to indicate that the PXCM is providing power to the Detector.

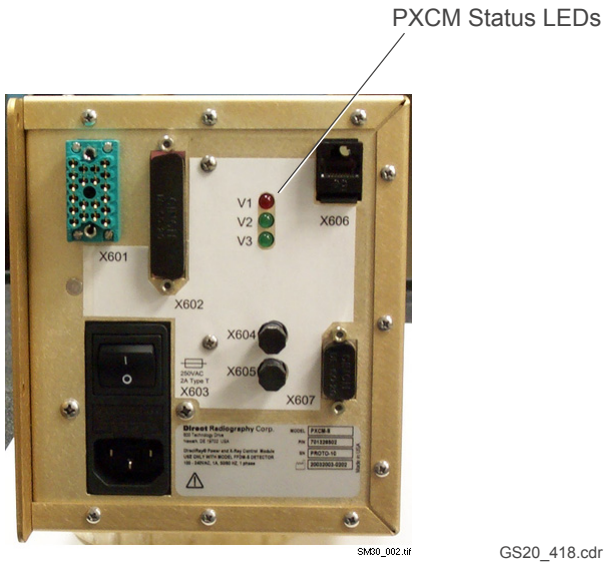


Figure 7-1. *DirectRay PXCM Status LEDs Location*

Reporting DirectRay Log Information

You may be asked by your central service support group to submit DirectRay log information related to a problem. You use the PXCM Web Tool, described in Chapter 5, to gather the relevant log files. You can then send the file to your central service support group for problem diagnosis.

8

Replacement

The chapter provides replacement guidelines for the DirectRay system components, and explains how to pack the Detector for shipment back to Direct Radiography Corp.

Replacement Guidelines

The field replaceable units for the DirectRay FFDM-S system include:

- DirectRay Detector
- DirectRay PXCM
- DirectRay Interface card
- Cables

There are no field-reparable units. If one of these components fail, you should replace the component with a new one and ship the failed component back to Direct Radiography Corp. For information on how the DirectRay components are secured and connected, refer to Chapter 3.

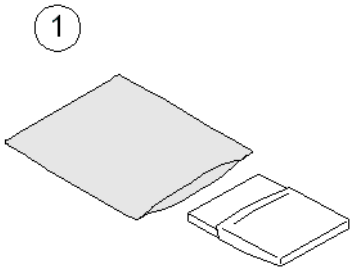
You may also have to reinstall DirectRay Detector or Power and X-ray Control Module (PXCM) software if it becomes corrupted. For software installation instructions, refer to Chapter 5.

Packing a DirectRay Detector for Shipment

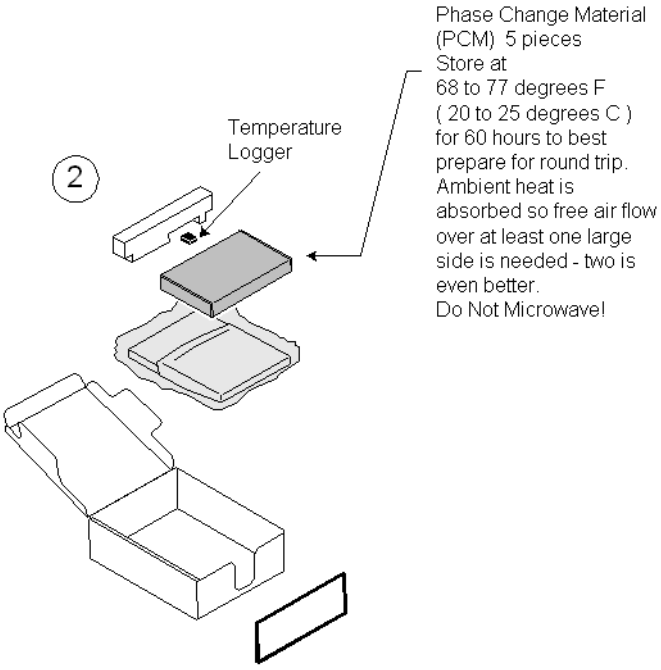
The DirectRay Detector must be properly packed before it is shipped.

To pack the Detector for shipping:

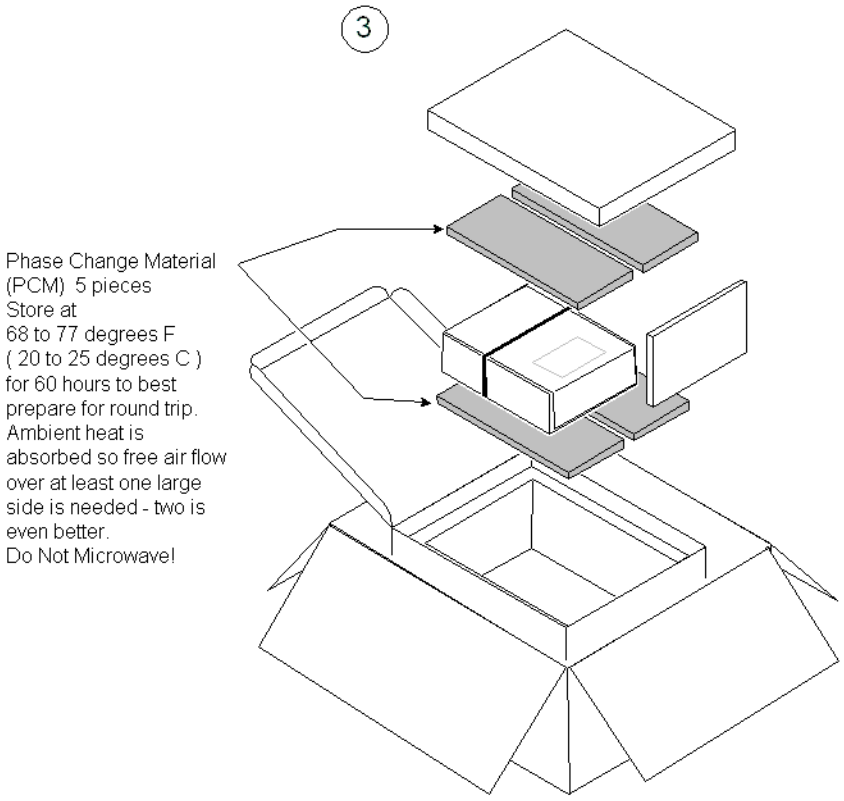
1. Locate the original packing material in which the Detector was shipped prior to installation, and place the Detector in its protective bag.



2. Place the Detector in its bag, the temperature logger, the packing insert, and the phase change material into the inner box, as shown below. Slide the lifting band over the box.

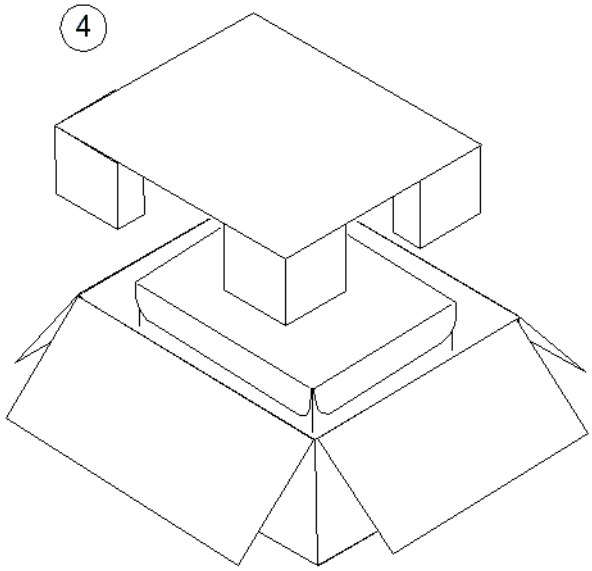


3. Place the inner box, the phase change material, and packing inserts in the outer box, as shown below.

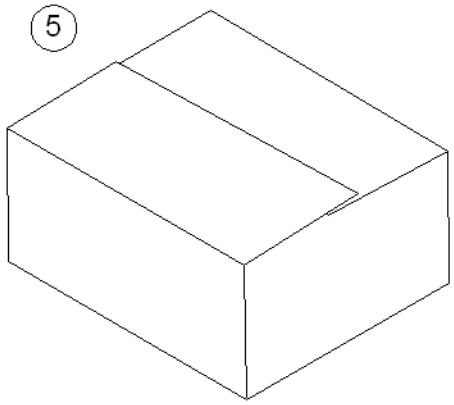


FFDM Outer Box (DRC p/n 701740001)
This takes the abuse in transit, protecting the FFDM-L and even the other parts of the packaging system. Inspect prior to each use and replace as needed.

4. Place the large packing insert between the inner and outer boxes, as shown below.



5. Tape the box closed.



A

Specifications

STILL UNDER DEVELOPMENT

DirectRay Detector, PXCM, and Interface Card General Specifications

Weight:

DirectRay Detector: X kg (X lb)

DirectRay PXCM: X kg (X lb)

DirectRay Interface Card: X kg (X lb)

Dimensions:

DirectRay Detector:

Width:	X cm (X in.)
Height:	X cm (X in.)
Depth:	X cm (X in.)

DirectRay PXCM:

Width:	X cm (X in.)
Height:	X cm (X in.)
Depth:	X cm (X in.)

DirectRay Interface Card:

Width:	X cm (X in.)
Height:	X cm (X in.)
Depth:	X cm (X in.)

Image Area:

Full field

Y x Y cm (Y x Y in.) nominal active image area

Detector Pixel:

X μm
Y x Y μm active element size
Y x Y detector element matrix
Y% geometric fill factor

Presampling MTF:

X% at Y.Y cycles/mm
X% at Y.Y cycles/mm
X% at Y.Y cycles/mm

Electrical

DirectRay Detector

TBD

DirectRay PXCM

100-240 V, 60/50 Hz, 1 A, 1 phase

Environment

Transit/Storage

DirectRay Detector

Temperature:	10° to 40°C (50 to 104°F), assuming the DirectRay Detector is shipped in an approved insulated shipping container
Maximum gradient:	X°C (X°F) per hour, assuming the unit is stored in an approved shipping container
Relative humidity:	X to X% (allow condensation dry time before installing)
Maximum gradient:	X% per hour

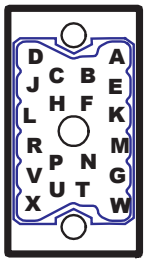
Operating

DirectRay Detector

Temperature:	20° to 35°C (68° to 95°F)
Maximum gradient:	X°C (X°F) per hour
Relative humidity:	10 to 80%, non-condensing
Maximum gradient:	X% per hour
Maximum altitude:	X m (X ft)
Maximum vibration:	X G RMS

PXCM Connector Locations and Pinouts

DirectRay Detector-to-PXCM Connection



Signal	Detector/PXCM Connector (X601) Pins
EL power	P
EL power com	R
+24vdc	S
24com	V
+24vdc	W
24com	X
+24vdc	T
24com	U
GND	L
GND	H
Data Shield	C
Data +	D
Data -	J
Serial Shield	N
Xmit +	A
Xmit -	E
Recv +	M
Recv -	K
Bot EL ON	F
(spare)	(no connection)
(spare)	(no connection)

PXCM-to-Generator Connection

Signal	PXCM Connector (X602) Pins	Comments
GEN_+5V_CTRL	DB25P-1	No connection.
PREP_DR_DET_	DB25P-2	
GEN_RDY_FOR_DR_EXP_	DB25P-3	
DR_DET_RDY_FOR_EXP_	DB25P-4	
DR_SYST_RDY_	DB25P-5	
DR_DET_ERR_	DB25P-6	
GEN_POWERED_ON_	DB25P-7	
X_RAY_ON_	DB25P-8	
(spare)	DB25P-9	
RxD	DB25P-10	
TxD	DB25P-11	
GEN_+5V_232	DB25P-12	X-ray equipment supplies +5 Vdc to power its side of the optocouplers.
(spare)	DB25P-13	No connection.
GND_CTRL	DB25P-14 to 21	
(spare)	DB25P-22	
GND_232	DB25P-23 to 25	

B

Field Replaceable Units

Part No.	Description
FFDM-S	DirectRay Full Field Digital Mammography Detector
PXCM-S	DirectRay Power and X-ray Control Module
DRIC-S	DirectRay Interface Card (PCI)

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